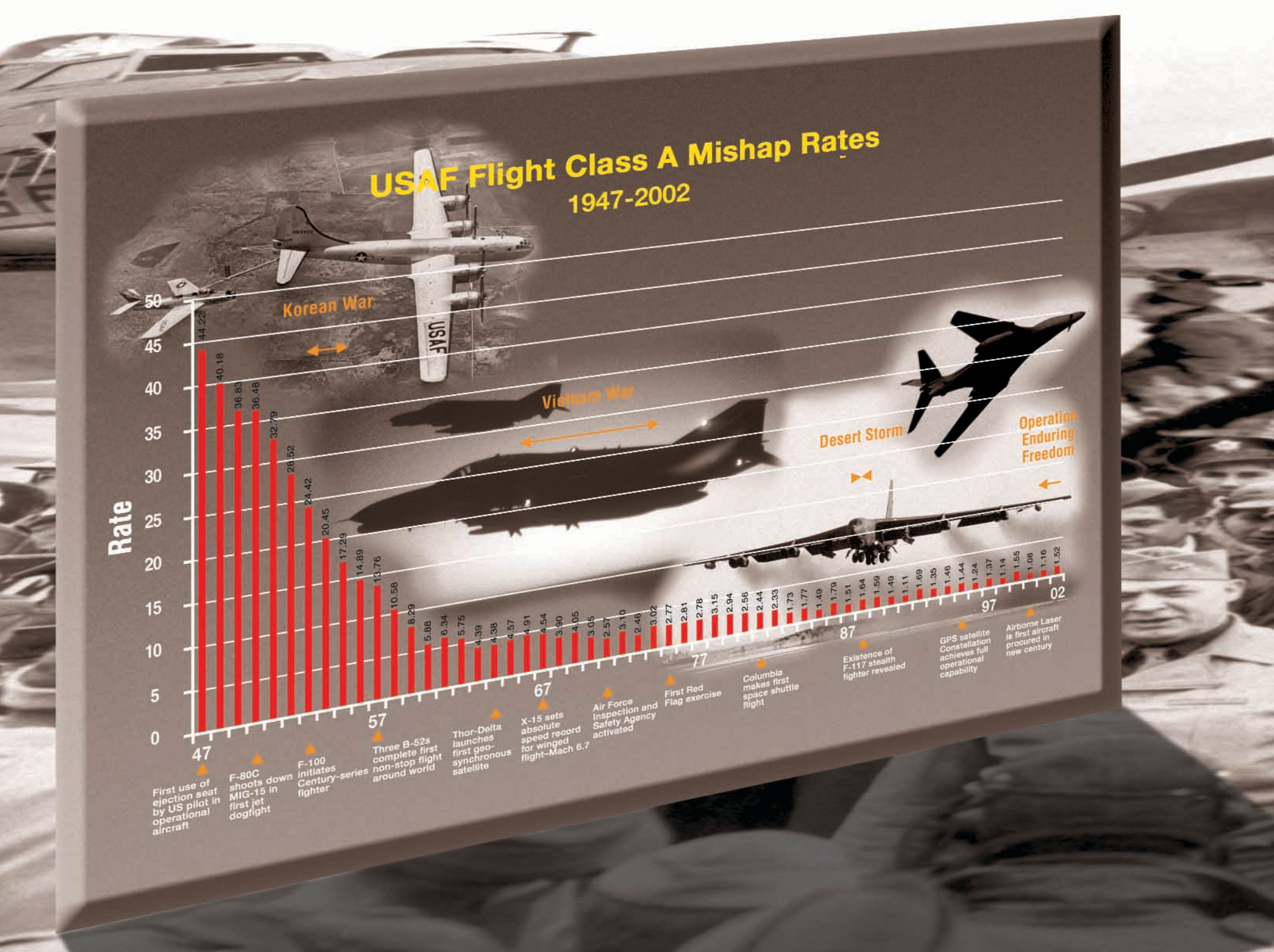
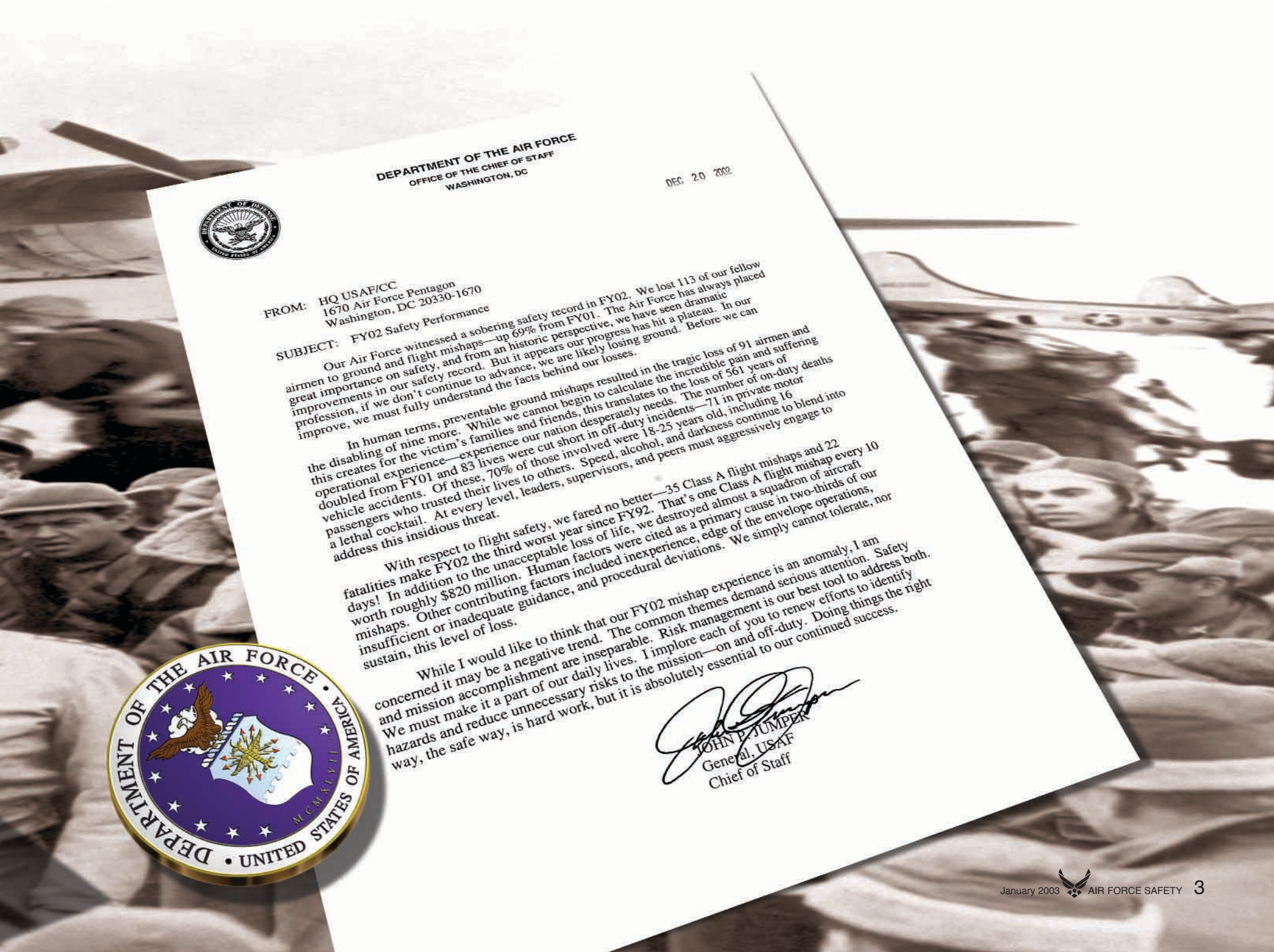
Air Force Safety Analysis

1993 – 2002


USAF Flight Class A Mishap Rates
1947-2002
Rate
Korean War
Vietnam War
Desert Storm
Operation Enduring Freedom
50
45
40
35
30
25
20
15
10
5
0
44.22
40.18
36.83
36.48
32.79
28.52
24.42
20.45
17.29
14.89
13.76
10.58
8.29
5.88
6.34
5.75
4.39
4.38
4.57
4.91
4.54
3.90
4.05
3.05
2.57
3.10
2.46
3.02
2.77
2.81
2.78
3.15
2.94
2.56
2.44
2.93
1.73
1.77
1.49
1.79
1.51
1.64
1.59
1.49
1.11
1.69
1.35
1.46
1.44
1.24
1.37
1.14
1.55
1.08
1.16
1.52
47
57
67
77
87
97
02
First use of ejection seat by US pilot in operational aircraft
F-80C shoots down MIG-15 in first jet dogfight
F-100 initiates Century-series fighter
Three B-52s complete first non-stop flight around world
Thor-Delta launches first geo-synchronous satellite
X-15 sets absolute speed record for winged flight–Mach 6.7
Air Force Inspection and Safety Agency activated
First Red Flag exercise
Columbia makes first space shuttle flight
Existence of F-117 stealth fighter revealed
GPS satellite Constellation achieves full operational capability
Airborne Laser is first aircraft procured in new century



DEPARTMENT OF THE AIR FORCE
OFFICE OF THE CHIEF OF STAFF
WASHINGTON, DC

DEC 20 2002

FROM: HQ USAF/CC
1670 Air Force Pentagon
Washington, DC 20330-1670

SUBJECT: FY02 Safety Performance

Our Air Force witnessed a sobering safety record in FY02. We lost 113 of our fellow airmen to ground and flight mishaps—up 69% from FY01. The Air Force has always placed great importance on safety, and from an historic perspective, we have seen dramatic improvements in our safety record. But it appears our progress has hit a plateau. In our profession, if we don't continue to advance, we are likely losing ground. Before we can improve, we must fully understand the facts behind our losses.

In human terms, preventable ground mishaps resulted in the tragic loss of 91 airmen and the disabling of nine more. While we cannot begin to calculate the incredible pain and suffering this creates for the victim's families and friends, this translates to the loss of 561 years of operational experience—experience our nation desperately needs. The number of on-duty deaths doubled from FY01 and 83 lives were cut short in off-duty incidents—71 in private motor vehicle accidents. Of these, 70% of those involved were 18-25 years old, including 16 passengers who trusted their lives to others. Speed, alcohol, and darkness continue to blend into a lethal cocktail. At every level, leaders, supervisors, and peers must aggressively engage to address this insidious threat.

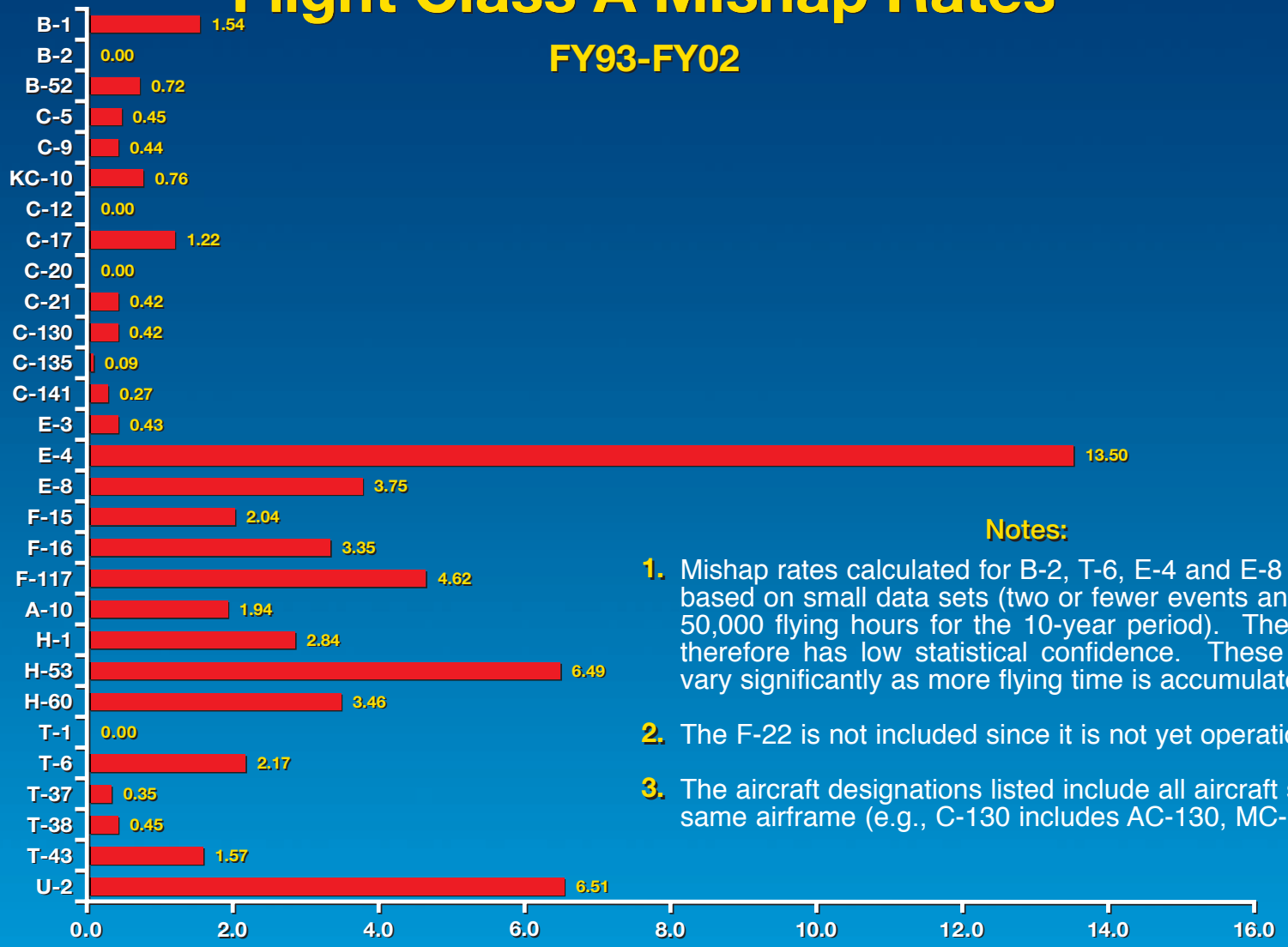
With respect to flight safety, we fared no better—35 Class A flight mishaps and 22 fatalities make FY02 the third worst year since FY92. That's one Class A flight mishap every 10 days! In addition to the unacceptable loss of life, we destroyed almost a squadron of aircraft worth roughly $820 million. Human factors were cited as a primary cause in two-thirds of our mishaps. Other contributing factors included inexperience, edge of the envelope operations, insufficient or inadequate guidance, and procedural deviations. We simply cannot tolerate, nor sustain, this level of loss.

While I would like to think that our FY02 mishap experience is an anomaly, I am concerned it may be a negative trend. The common themes demand serious attention. Safety and mission accomplishment are inseparable. Risk management is our best tool to address both. We must make it a part of our daily lives. I implore each of you to renew efforts to identify hazards and reduce unnecessary risks to the mission—on and off-duty. Doing things the right way, the safe way, is hard work, but it is absolutely essential to our continued success.

JOHN P. JUMPER
General, USAF
Chief of Staff

Flight Class A Mishap Rates

FY93-FY02



Notes:

1. Mishap rates calculated for B-2, T-6, E-4 and E-8 aircraft are based on small data sets (two or fewer events and less than 50,000 flying hours for the 10-year period). The listed rate therefore has low statistical confidence. These rates may vary significantly as more flying time is accumulated.
2. The F-22 is not included since it is not yet operational.
3. The aircraft designations listed include all aircraft sharing the same airframe (e.g., C-130 includes AC-130, MC-130, etc.).

The 3 mishap classes addressed in this analysis are:

Class A: Destruction of an Air Force aircraft; a fatality or permanent total disability; or total mishap cost of $1,000,000 or more.

Class B: A permanent partial disability; inpatient hospitalization of three or more personnel; or total mishap cost of $200,000 but less than $1,000,000.

Class C: An injury resulting in a lost workday case or total mishap cost of $20,000 but less than $200,000.

This analysis includes 3 broad categories of mishaps:

Aviation – Aircraft (Flight, Flight-related, Ground Ops); Unmanned Aerial Vehicle (UAV); and Non-DoD Aviation mishaps.

Ground – On-Duty and Industrial; Motor Vehicle; Off-Duty Military; Fire and Maritime mishaps.

Space, Explosives, and Missiles – Explosive - mishap involving conventional explosives or chemical agents; Missile - mishap involving tactical or training missiles, ICBMs; or sub-scale remotely piloted vehicles (RPVs); Space - mishap involving space systems and/or unique space support equipment.

Mishap costs. Three methods are defined for determining the mishap cost - Acquisition Cost, Replacement Cost, or Repair Cost. The method used varies with the mishap and the equipment involved. In addition, the Class C threshold was increased from $10,000 to $20,000 in Mar 01. Fatality and injury costs are based upon standardized DoD cost factors (baselined to FY88).

Mishap rates. Aircraft Flight and UAV mishap rates are calculated per 100,000 flying hours. Ground mishap rates are calculated per 100,000 personnel.

Aviation mishap terms:
Destroyed aircraft includes only USAF aircraft.
Fatalities include all DoD service members, foreign military members and civilians killed in USAF aircraft flight mishaps.

Ground mishap terms:
PMV-2 - Private Motor Vehicle with 2 wheels (motorcycles).
PMV-4 - Private Motor Vehicle with 4 or more wheels (cars, trucks, etc.).

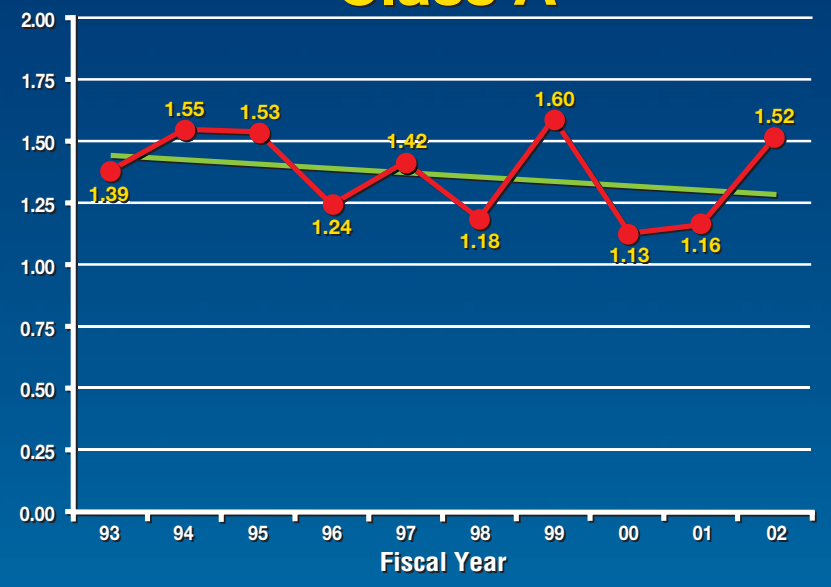
Additional category-specific notes and definitions are provided at the end of each section.

Data used in this analysis is derived from mishap reports submitted in accordance with AFI 91-204, *Safety Investigations and Reports*. For more detailed explanation of terms, definitions, mishap cost calculations and classifications, see AFI 91-204.

Aviation

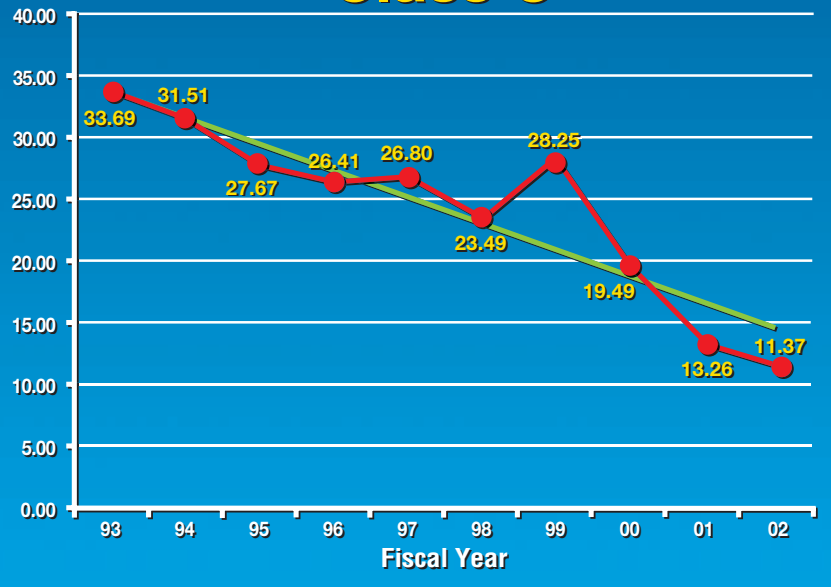
Flight Mishap Rates

Class A



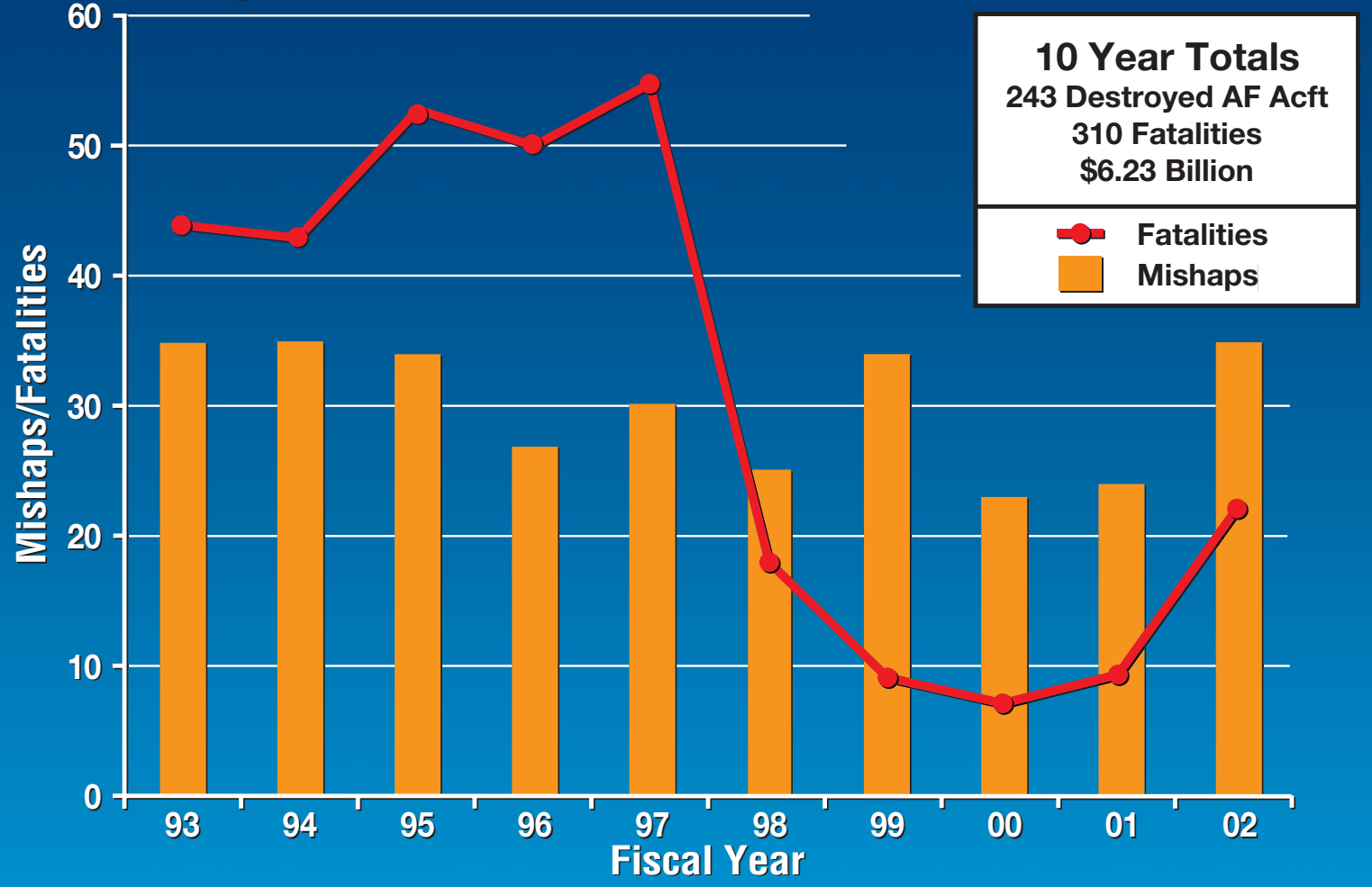
Class B

Class C



See additional note on page 23.

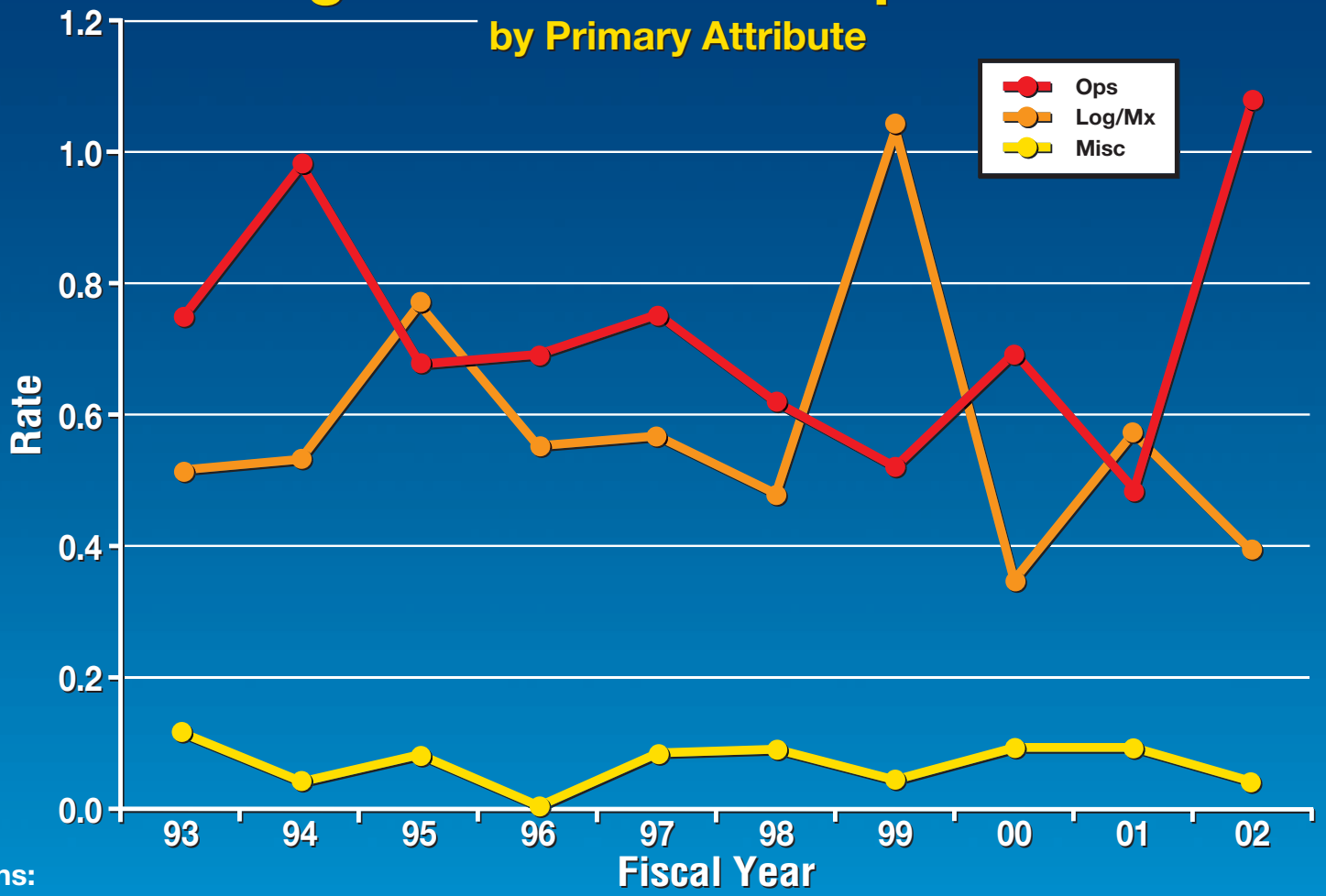
Flight Class A Mishaps and Costs



Cost in $M (FY01 $)	$806.7	$729.0	$638.9	$412.2	$792.8	$713.2	$645.1	$284.9	$384.5	$820.3
Destroyed AF Acft	36	35	29	20	24	20	25	14	21	19

Flight Class A Mishap Rates

by Primary Attribute



Definitions:

Operations – Primarily attributed to deficiencies involving flying operations, to include air traffic control, operational guidance, flight crew training, and flying supervision.

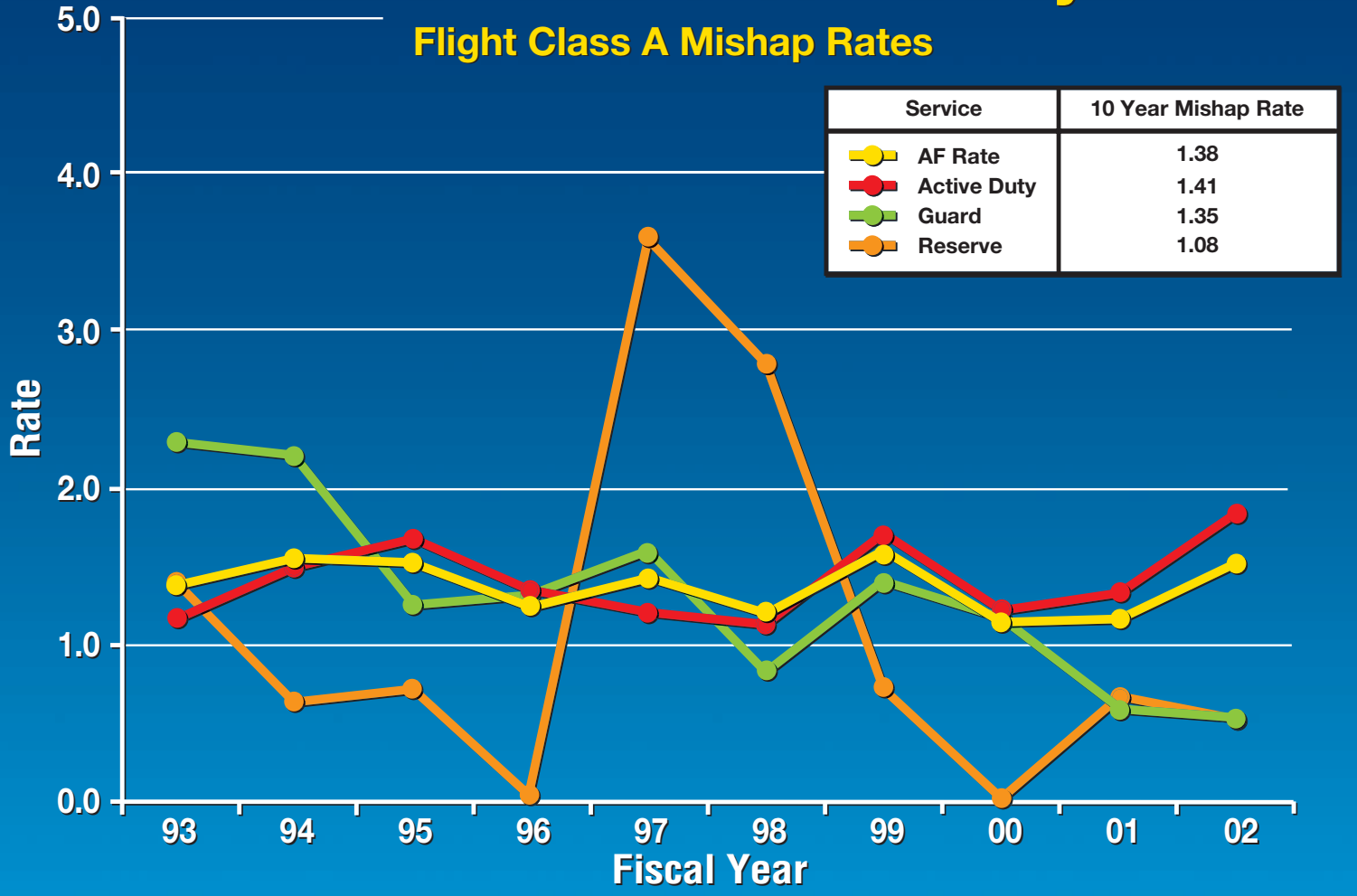
Logistics/Maintenance – Primarily attributed to deficiencies involving the design, manufacture, overhaul, repair, maintenance, or servicing of aircraft.

Miscellaneous – Primarily attributed to wildlife strikes, effects of environment or weather, or where insufficient information exists to otherwise attribute.

See additional note on page 23.

Reserve/Guard/Active Duty

Flight Class A Mishap Rates



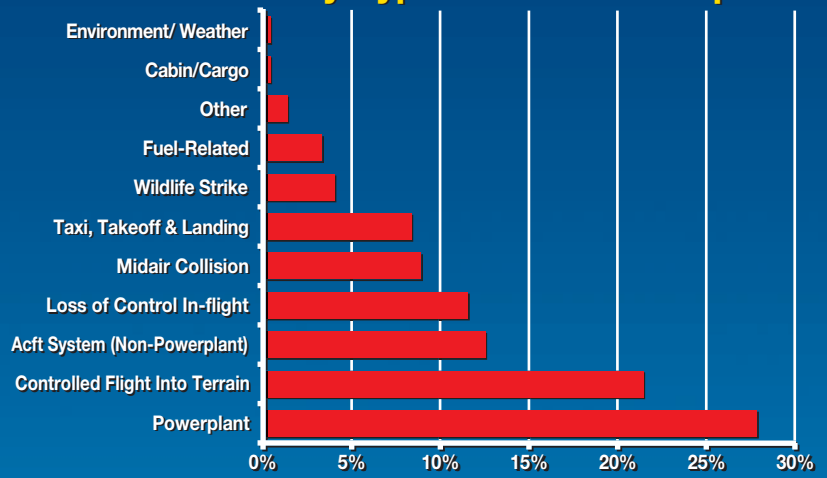
Service	10 Year Mishap Rate
AF Rate	1.38
Active Duty	1.41
Guard	1.35
Reserve	1.08

See additional note on page 23.

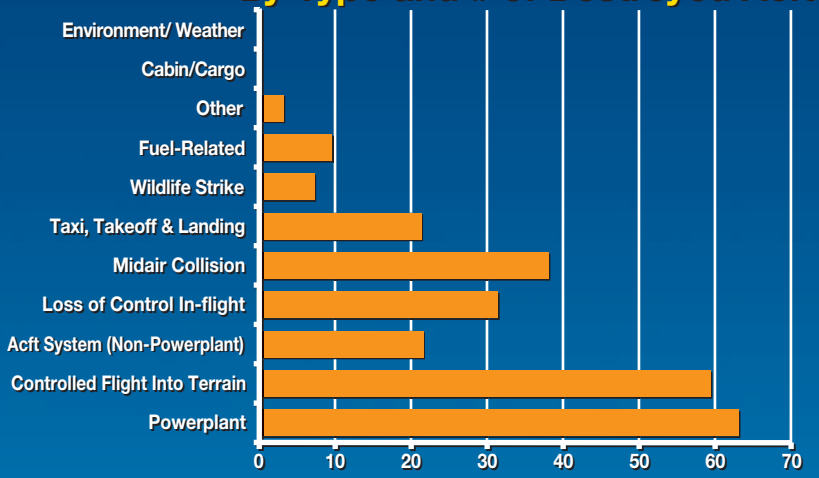
Flight Class A Mishaps

FY93-FY02

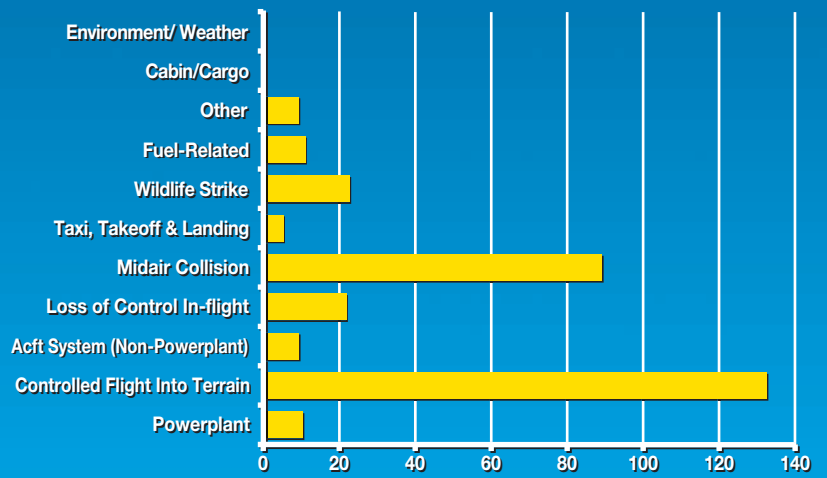
By Type and # of Mishaps



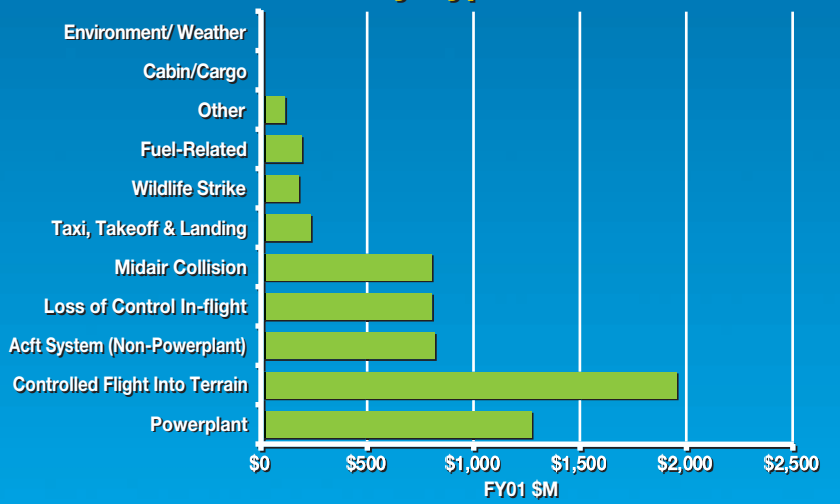
By Type and # of Destroyed Acft



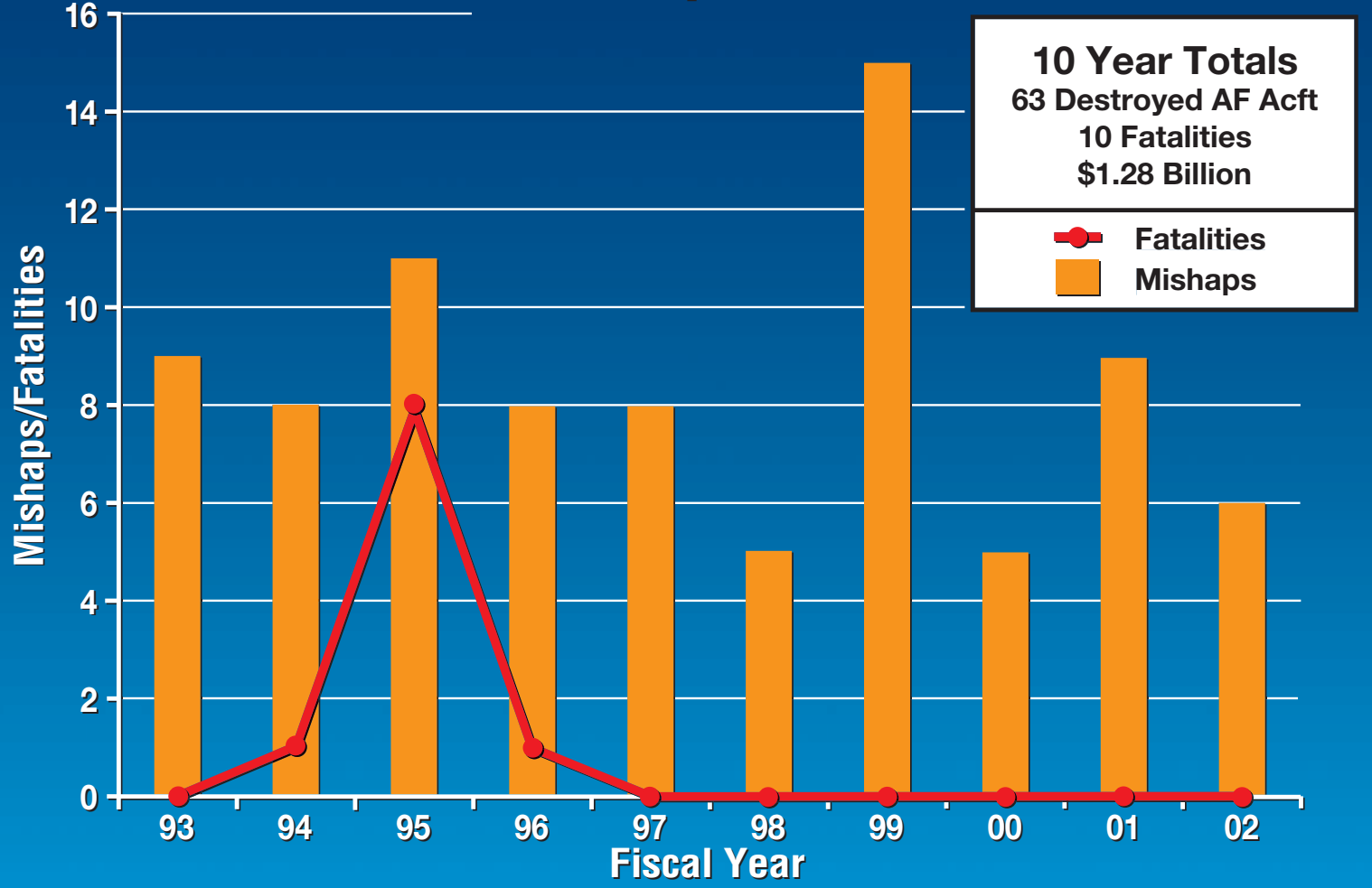
By Type and # of Fatalities



By Type and Cost



Powerplant

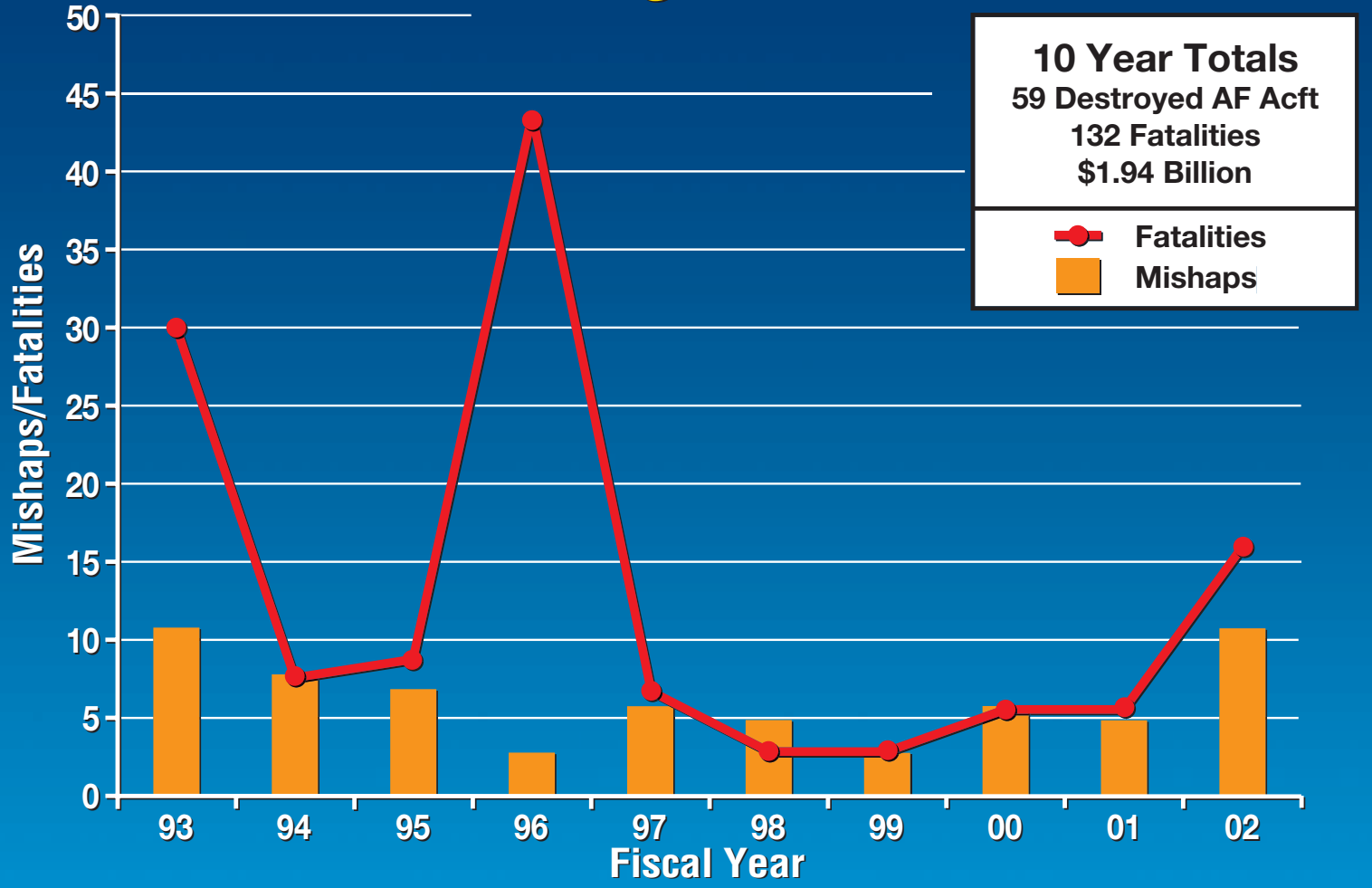


Cost in $M (FY01 $)	$119.6	$116.3	$193.2	$145.4	$149.5	$82.4	$195.3	$69.6	$145.4	$66.8
Destroyed AF Acft	9	6	10	6	7	3	9	3	7	3

Definition: Failure or malfunction of an aircraft thrust-producing system or related component.

See additional notes on page 23.

Controlled Flight into Terrain

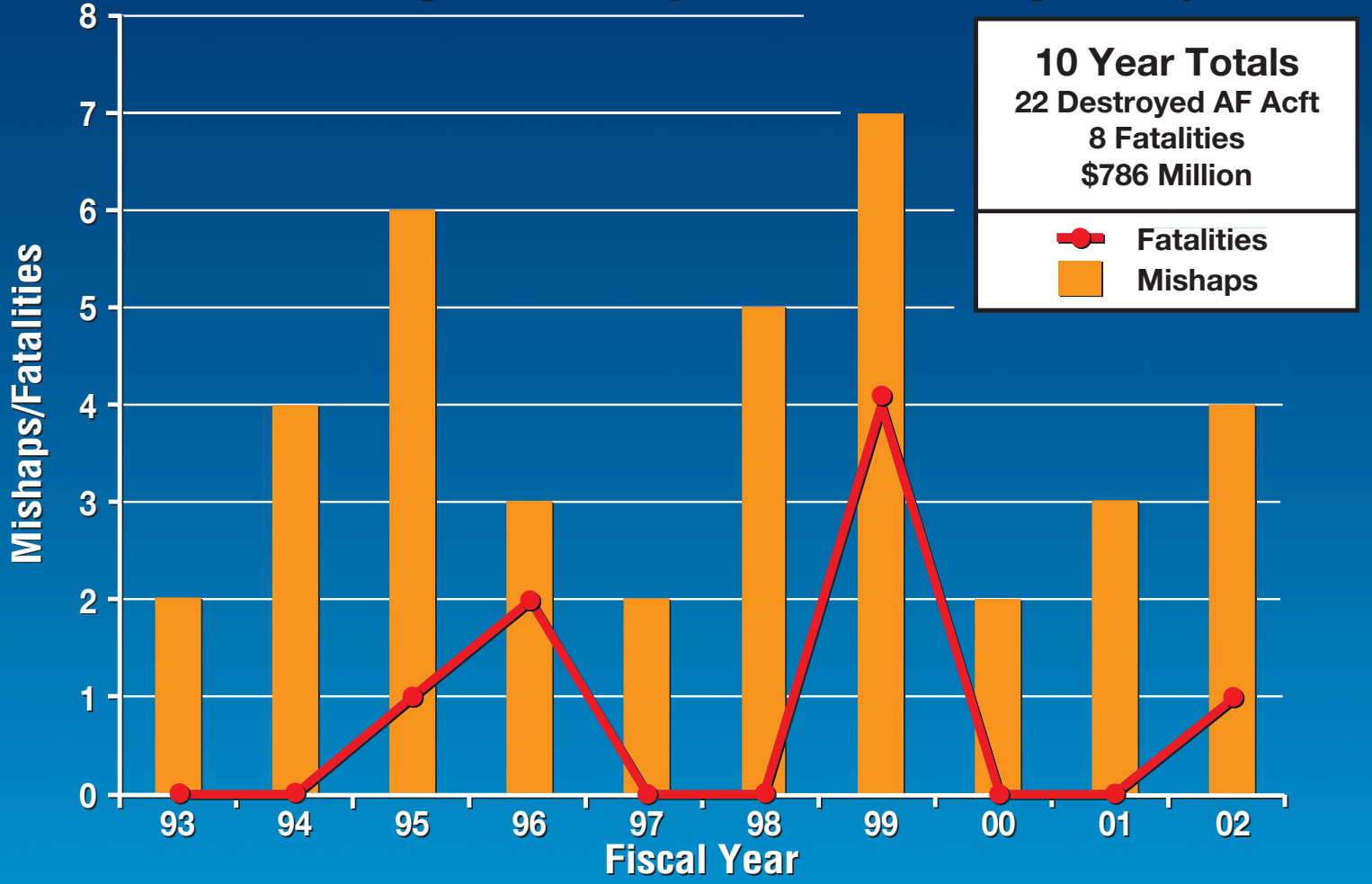


Cost in $M (FY01 $)	$453.7	$187.4	$166.6	$57.5	$386.2	$93.3	$81.4	$62.7	$138.6	$316.6
Destroyed AF Acft	11	7	7	3	6	5	3	3	6	8

Definition: In-flight collision with terrain, water, trees, or a man-made obstacle during forward flight.

See additional notes on page 23.

Aircraft Systems (Non-Powerplant)

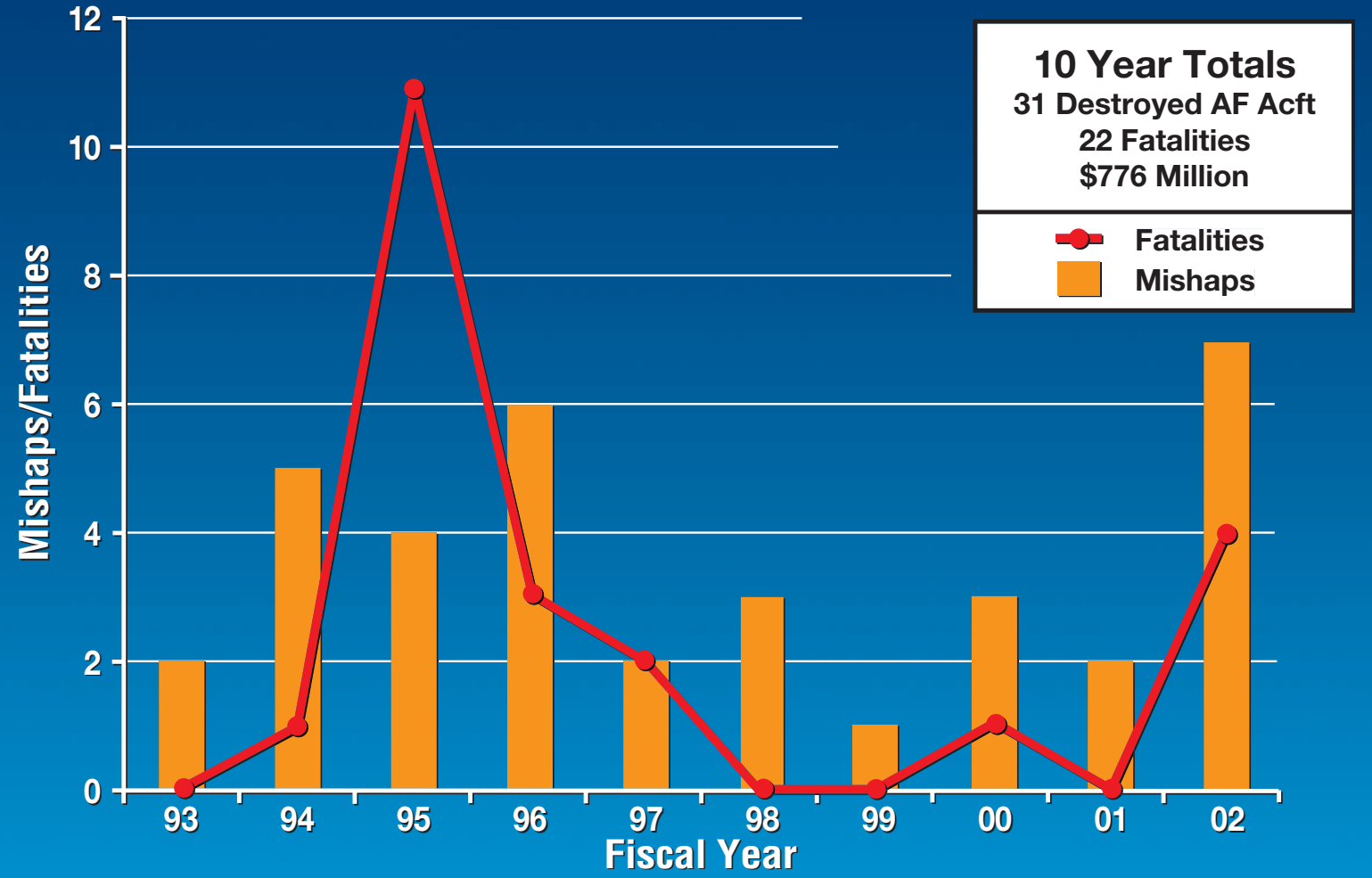


Cost in $M (FY01 $)	$42.1	$23.1	$65.6	$64.5	$59.2	$359.5	$94.8	$16.0	$9.7	$52.3
Destroyed AF Acft	2	4	4	3	1	3	3	0	1	1

Definition: Failure or malfunction of an aircraft system or component–other than the powerplant.

See additional notes on page 23.

Loss of Control In-Flight

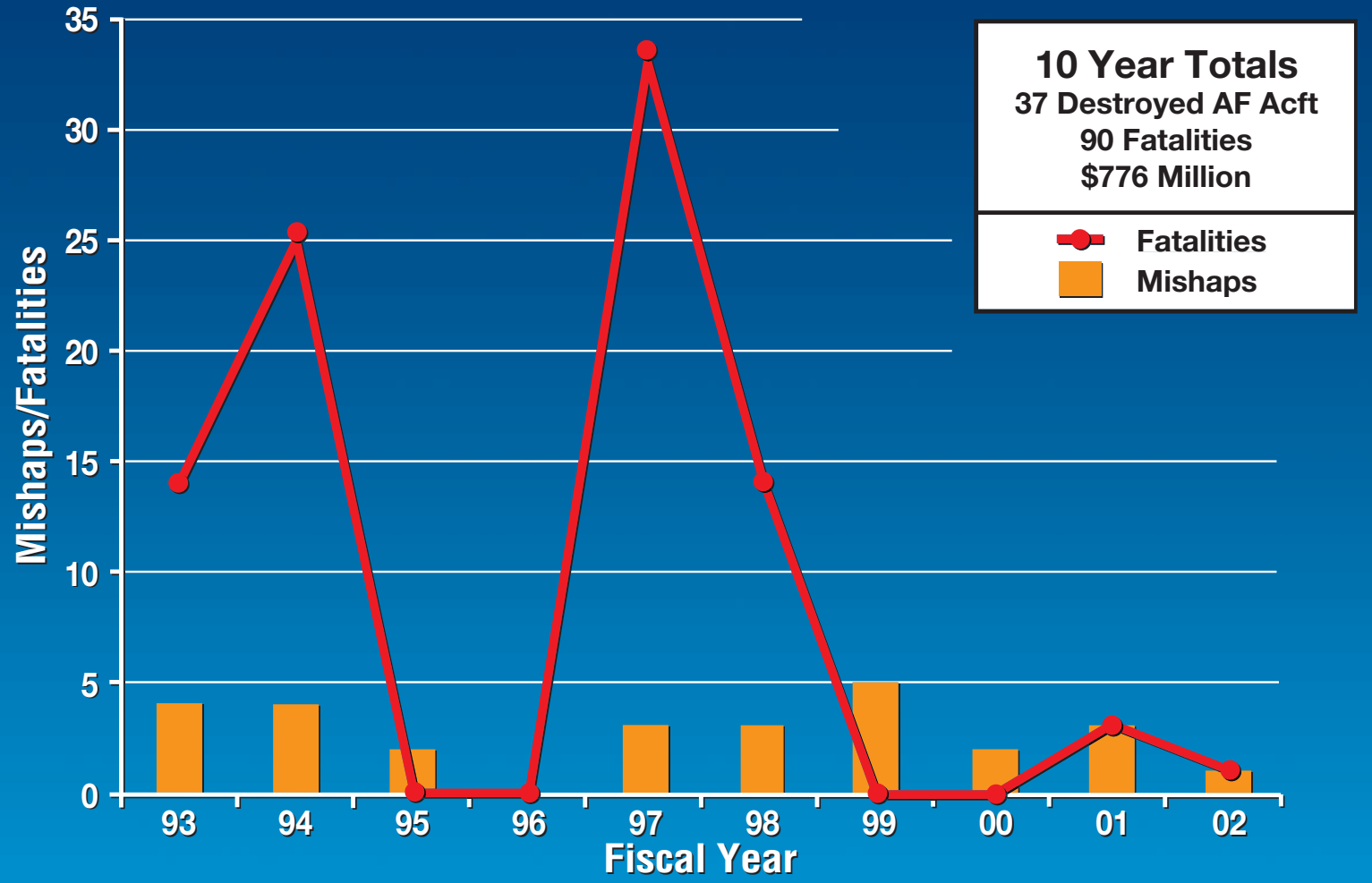


Cost in $M (FY01 $)	$19.6	$64.9	$93.7	$96.2	$23.4	$74.2	$10.9	$35.8	$11.7	$345.9
Destroyed AF Acft	2	4	4	6	2	3	1	3	2	4

Definition: Loss of aircraft control while in flight.

See additional notes on page 23.

Midair Collisions

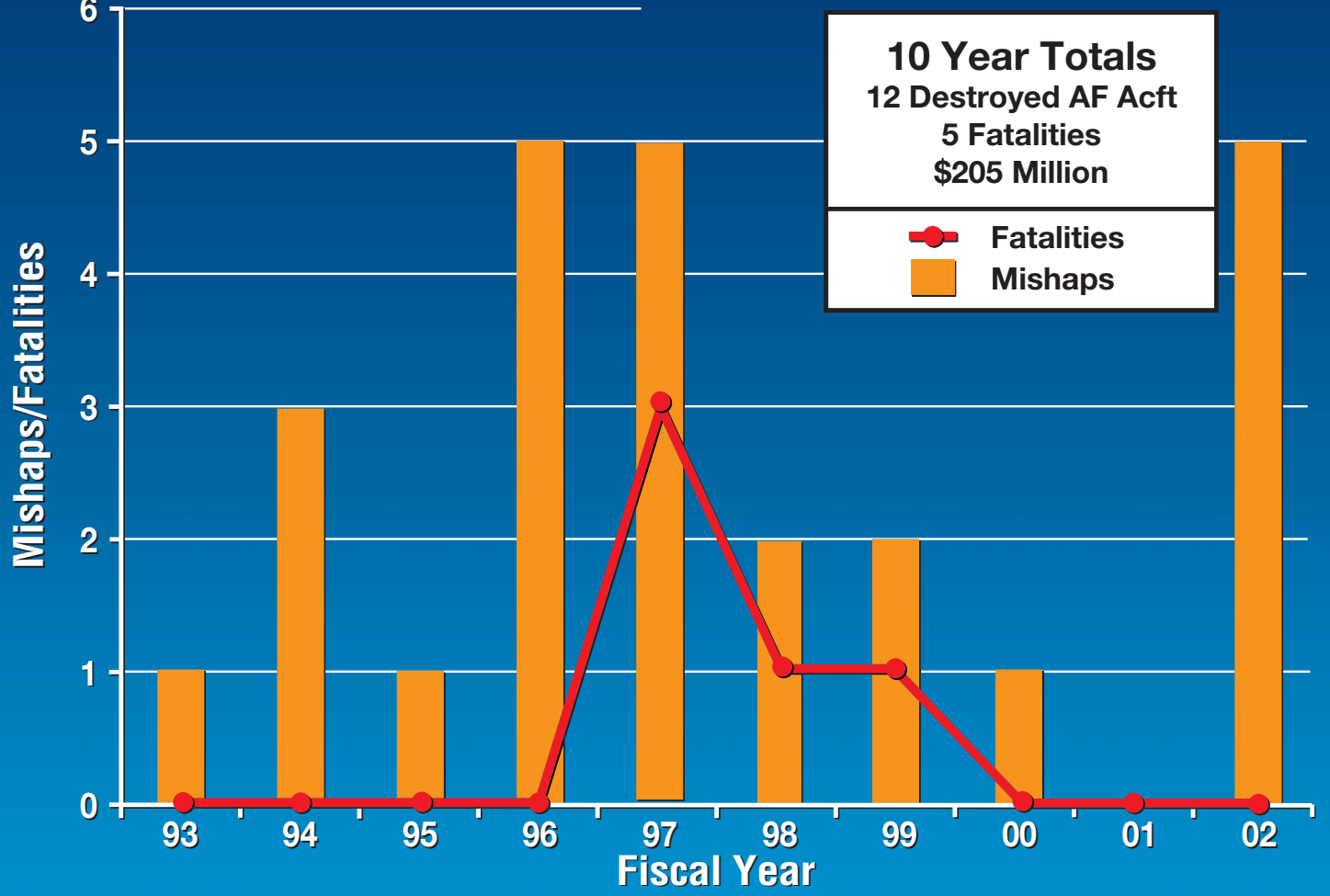


Cost in $M (FY01 $)	$96.3	$151.4	$20.7	$0	$81.3	$62.6	$217.1	$46.2	$74.6	$25.5
Destroyed AF Acft	5	8	1	0	3	4	7	2	5	2

Definition: Collision between aircraft when intent for flight exists.

See additional notes on page 23.

Taxi, Takeoff & Landing

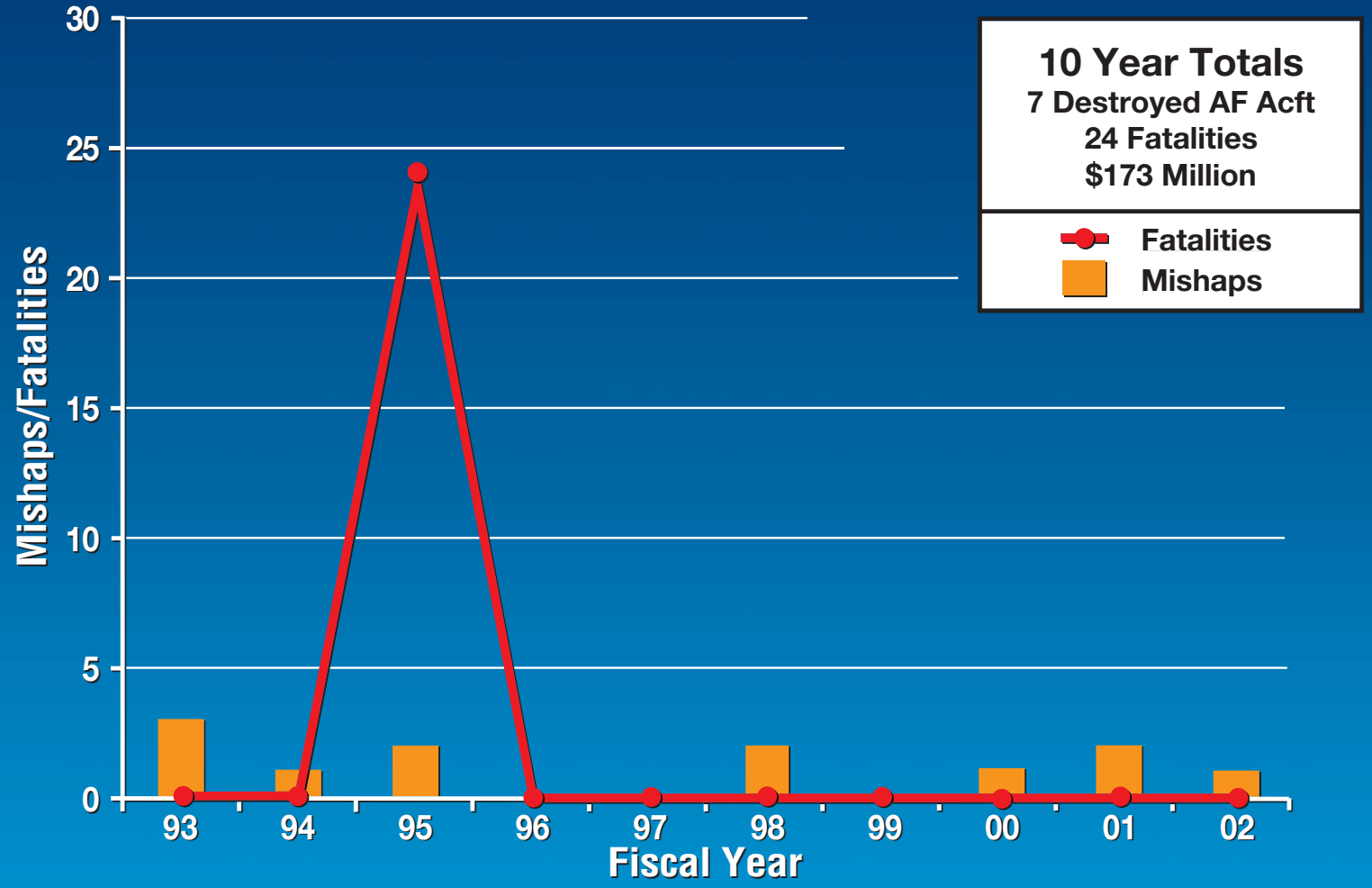


Cost in $M (FY01 $)	$10.4	$77.3	$1.7	$27.7	$29.0	$22.2	$24.3	$1.9	$0	$10.8
Destroyed AF Acft	1	3	1	1	3	1	1	0	0	1

Definition: Occurrences during takeoff, landing or other powered aircraft movement on prepared surfaces.

See additional note on page 23.

Wildlife Strike

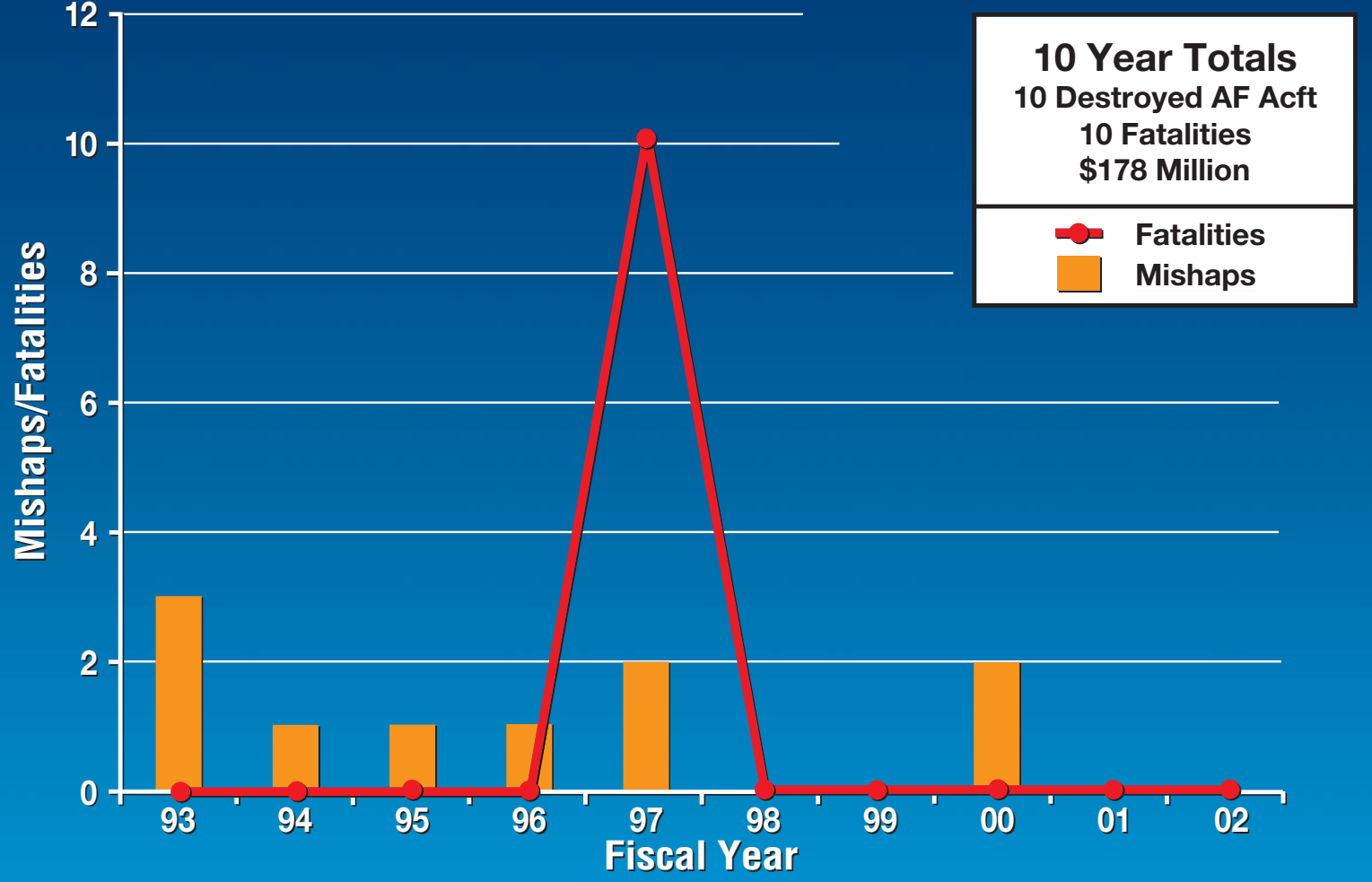


Cost in $M (FY01 $)	$13.4	$10.1	$97.4	$0	$0	$19.0	$0	$25.8	$4.5	$2.4
Destroyed AF Acft	3	1	1	0	0	1	0	1	0	0

Definition: Collision with bird or other animal.

See additional notes on page 23.

Fuel-Related

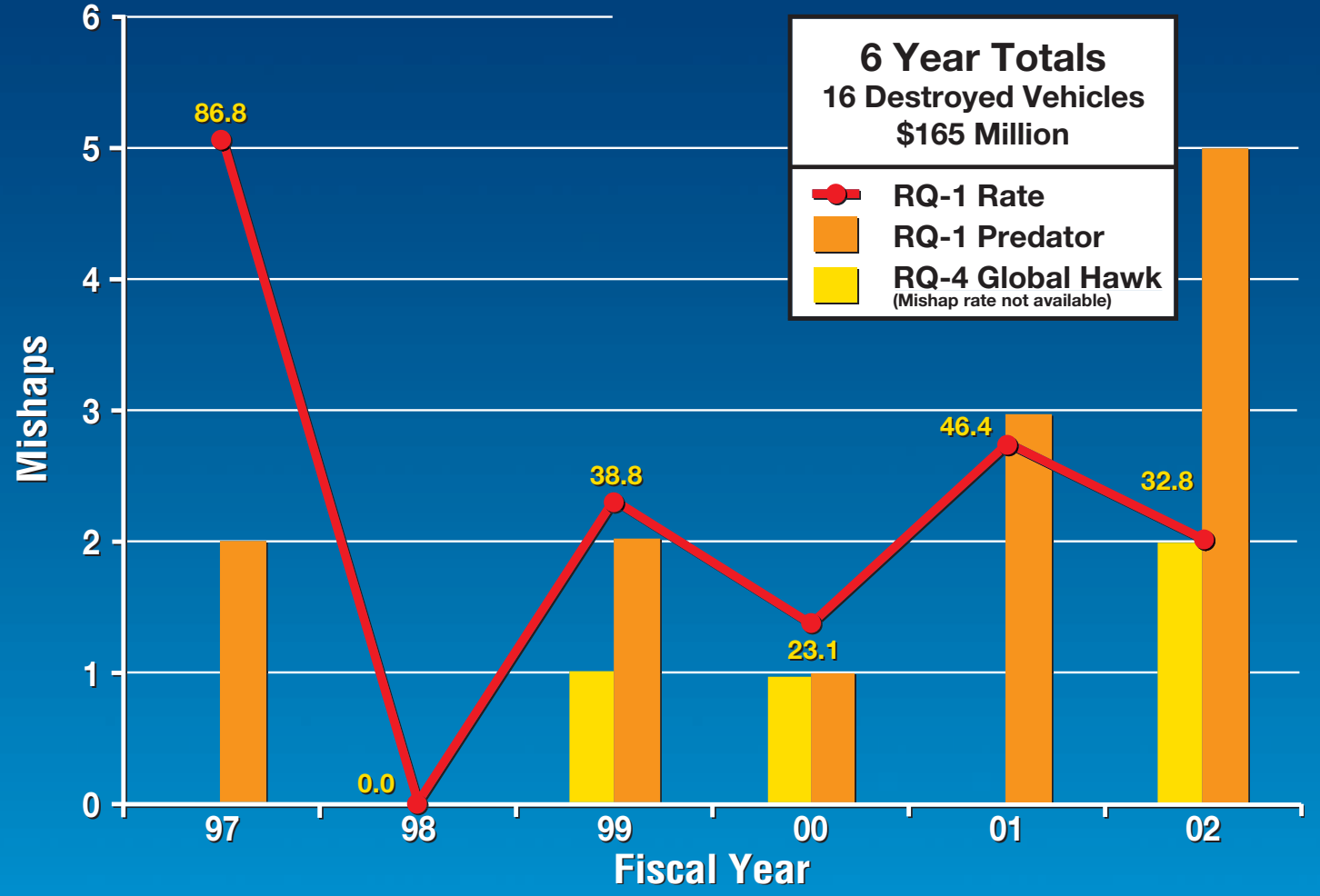


Cost in $M (FY01 $)	$51.8	$20.8	$0	$18.8	$61.5	$0	$0	$25.4	$0	$0
Destroyed AF Acft	3	1	1	1	2	0	0	2	0	0

Definition: One or more powerplants experienced reduced or no power output due to a fuel anomaly.

See additional notes on page 23.

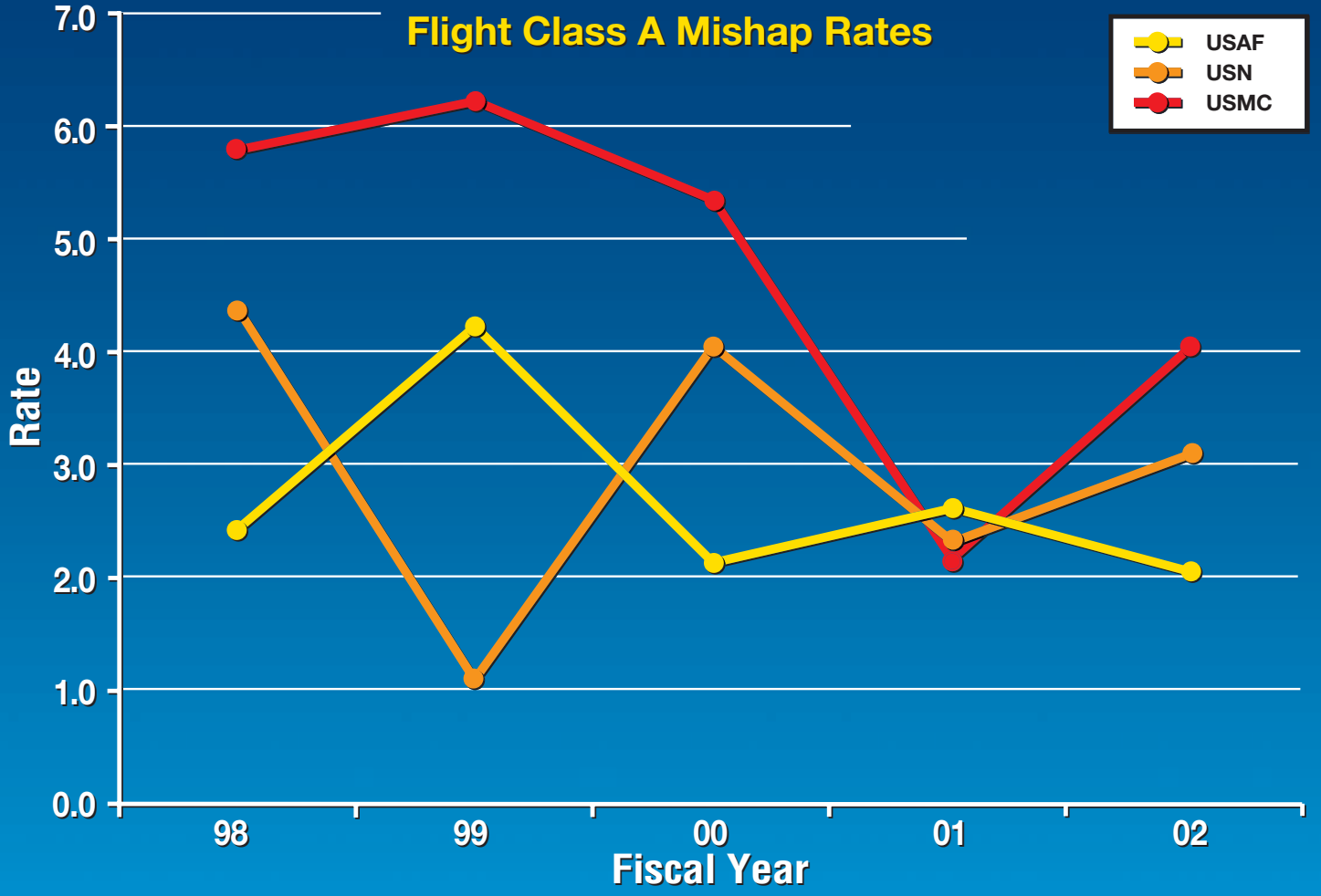
UAV Mishap Data



Cost in $M	$3.1	$0	$49.0	$9.0	$7.9	$95.6
Destroyed RQ-1s	1	0	2	1	3	5
Destroyed RQ-4s	0	0	1	0	0	2

Note: UAV mishaps do not count toward the aircraft flight Class A mishap rate.

Multi-Service Fighter/Attack



Note: Includes fixed-wing fighter/attack aircraft only. USAF includes F-15, F-16, F-117 and A/OA-10 only.

Aviation Summary

- Historical trend positive but little improvement in past decade
- Losses in the past 10 years unacceptably high
  - Destroyed equivalent of 1 squadron of aircraft (24.3) per year
  - Lost an average of $623M in AF resources per year
  - Killed an average of 31 people each year
- Controlled Flight into Terrain takes greatest toll
  - Average 6 destroyed aircraft per year
  - Average 13 fatalities per year
- Undesired trend reversal in last 2 fiscal years
- Number of Class A mishaps, rates, and fatalities are rising
- Corrective measures need to target the big drivers

Notes:

1. P. 7. Recent Class B spike is attributed primarily to efforts to improve reporting of damaged asset mishaps, especially in aircraft engines. Improved reporting has identified previously neglected problems. Decline in FY01-02 indicates those problems are now being addressed.

2. P. 9. An unusually high number of fighter powerplant-related mishaps drove the Log/Mx rate higher in FY99. Flight crews pressing for mission accomplishment despite high operational risk factors drove an Ops rate spike in FY02. Helicopters accounted for 9 of 25 Ops mishaps.

3. P. 10. The relatively low AF Reserve flight hours cause their five mishaps in FY97 and four in FY98 to show as a large spike in their rate. These nine mishaps were all unrelated, indicating no discernible trend.

4. Pp. 12-19. The mishap type is generally the precipitating event, the predominant factor contributing to the severity of the mishap, or the category that best describes the overall mishap. It is not the cause of the mishap.

5. P. 12. Powerplant. Seven similar fighter engine mishaps, with two main causes, drove the FY99 spike. A C-130 mishap accounted for six fatalities in FY95.

6. P. 13. Controlled Flight into Terrain. The FY93 spike in fatalities was driven by an H-60 mishap (12 fatalities) and a C-130 mishap (6 fatalities). In FY96, 35 fatalities occurred in a T-43 mishap. Cost spikes in FY93 and FY97 were the result of B-1 mishaps. Three C-130 mishaps caused the high cost in FY02.

7. P. 14. Aircraft Systems (Non-Powerplant). A B-1 mishap accounted for $283M of the FY98 costs.

8. P. 15. Loss of Control In-flight. In FY95, eight fatalities resulted from a C-21 mishap. A B-1 mishap accounted for $293M in FY02.

9. P. 16. Midair Collisions. An FY93 midair between two C-141s resulted in 13 fatalities. An F-16/C-130 midair with 23 ground fatalities drove the FY94 spike. All 33 fatalities in FY97 resulted from a C-141/Tu-154 mishap. There were 12 fatalities in an FY98 midair between two H-60s. Three F-15/F-15 mishaps drove up FY99 costs by $169M.

10. P. 18. Wildlife Strike. An FY95 E-3 mishap accounted for all 24 fatalities and an $83M loss.

11. P. 19. Fuel-Related. A C-130 mishap accounted for all 10 fatalities in FY97. The FY95 destroyed aircraft was a Civil Air Patrol Cessna mishap with a $17K cost.

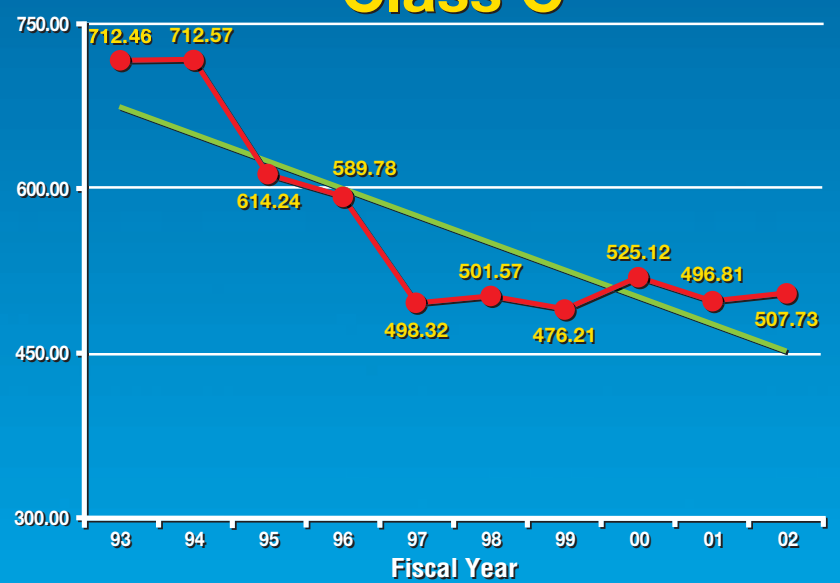
Ground

Ground Mishap Rates

Class A

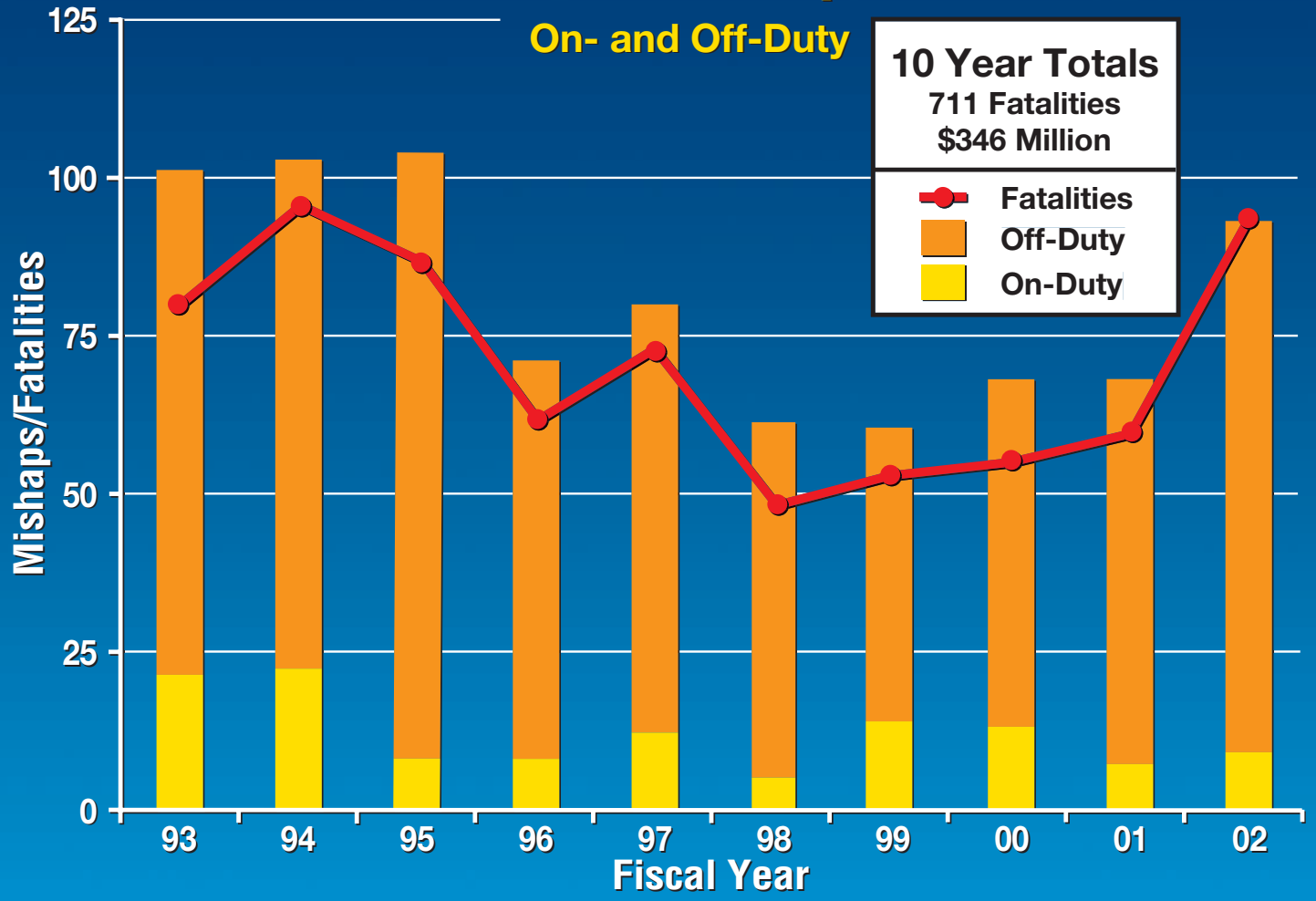
Class B

Class C



See additional note on page 33.

Ground Class A Mishaps and Costs

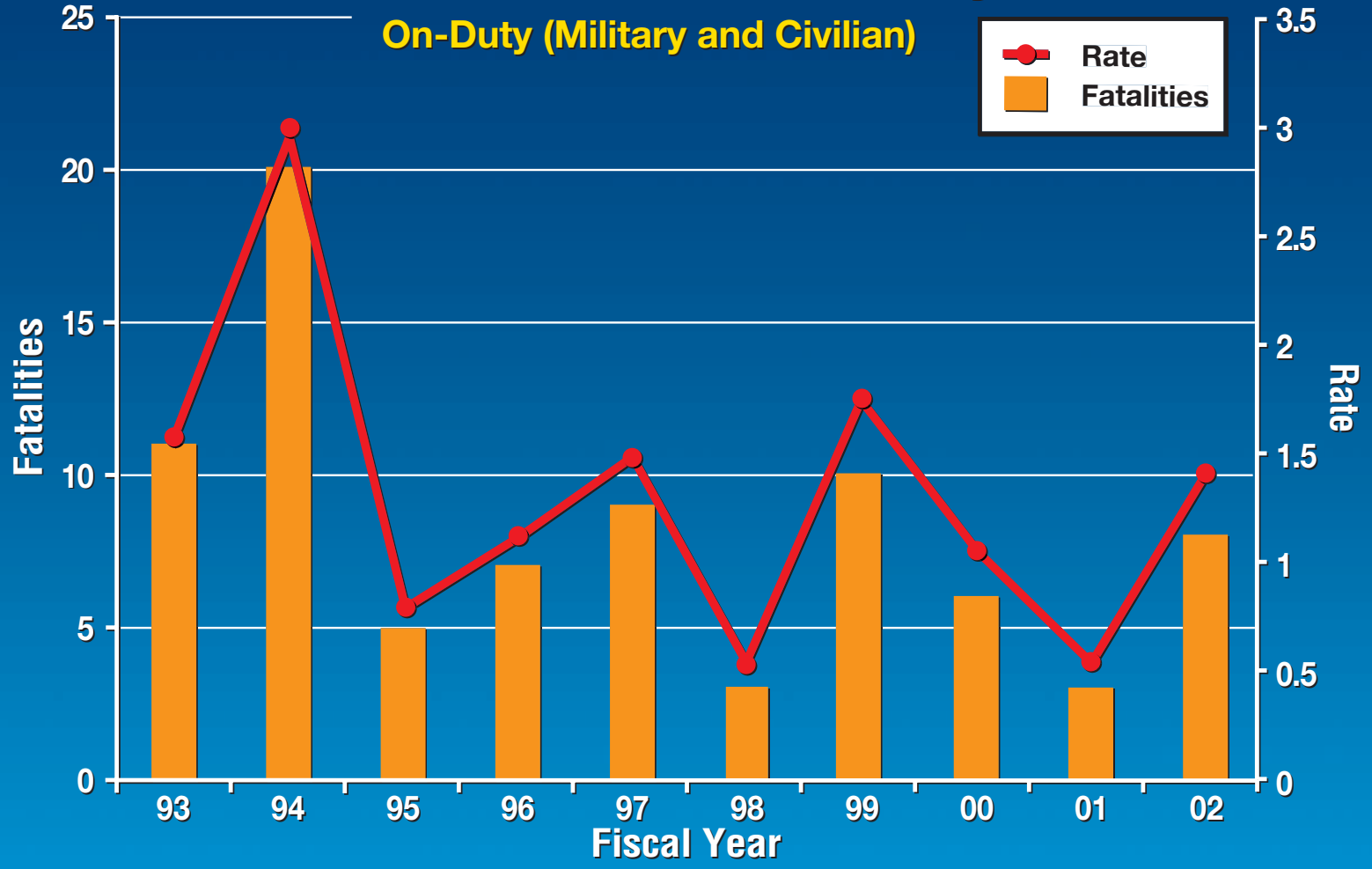


Cost in $M	$32	$103	$29	$20	$18	$24	$68	$21	$20	$11

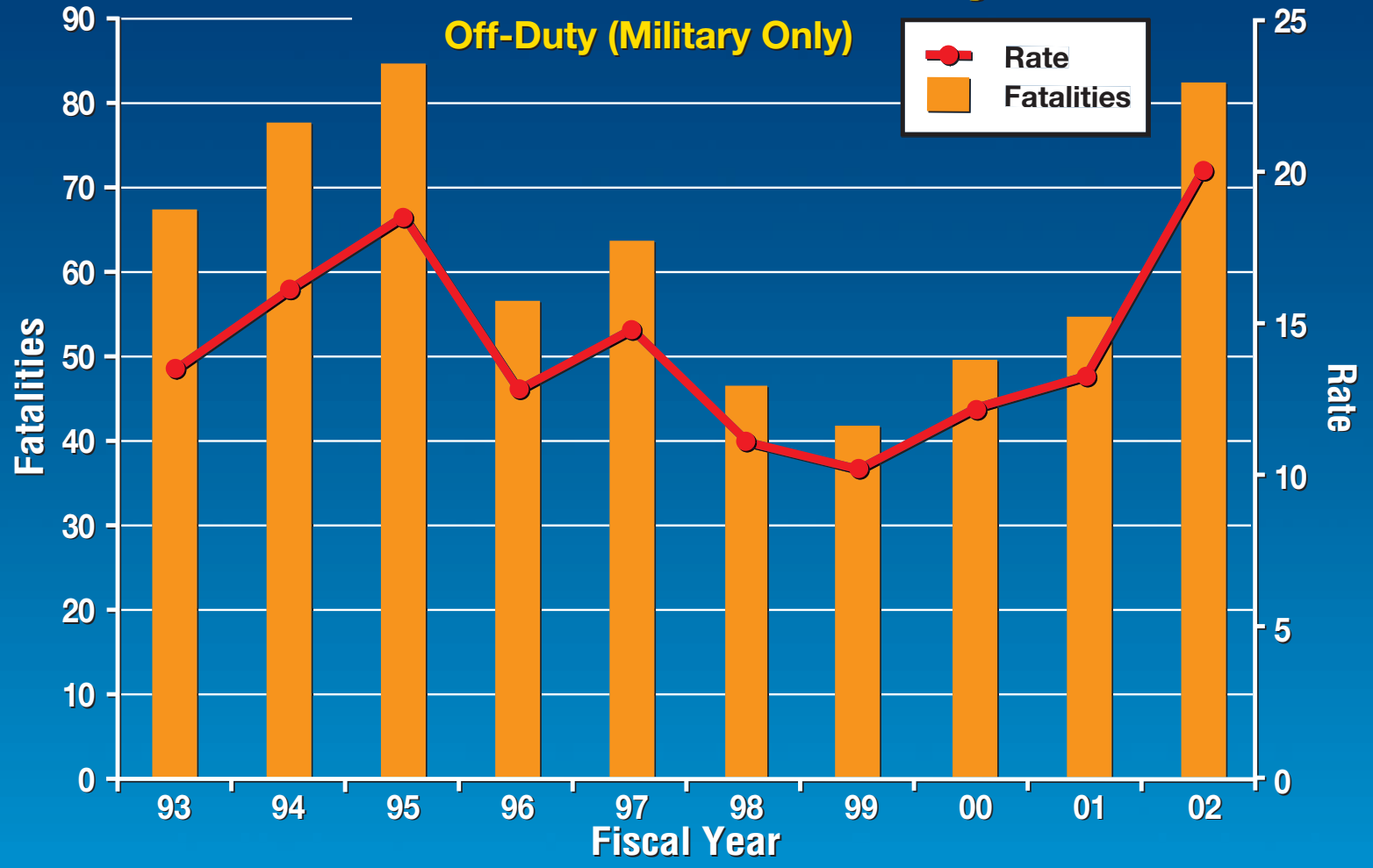
Note: Costs are based on the direct personnel values and actual property costs, IAW AFI 91-204.

See additional notes on page 33.

Ground Fatalities and Fatality Rates

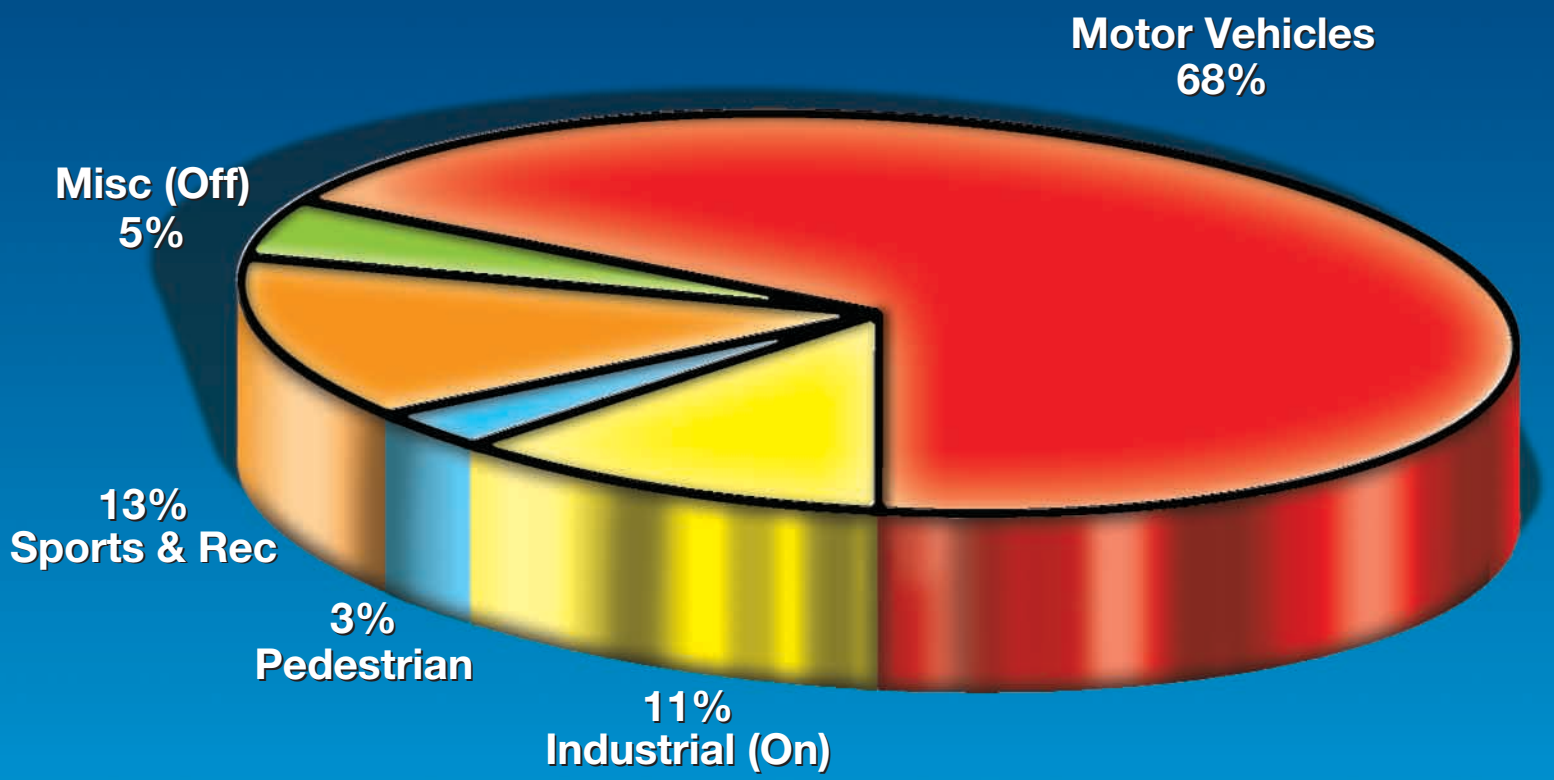


Ground Fatalities and Fatality Rates

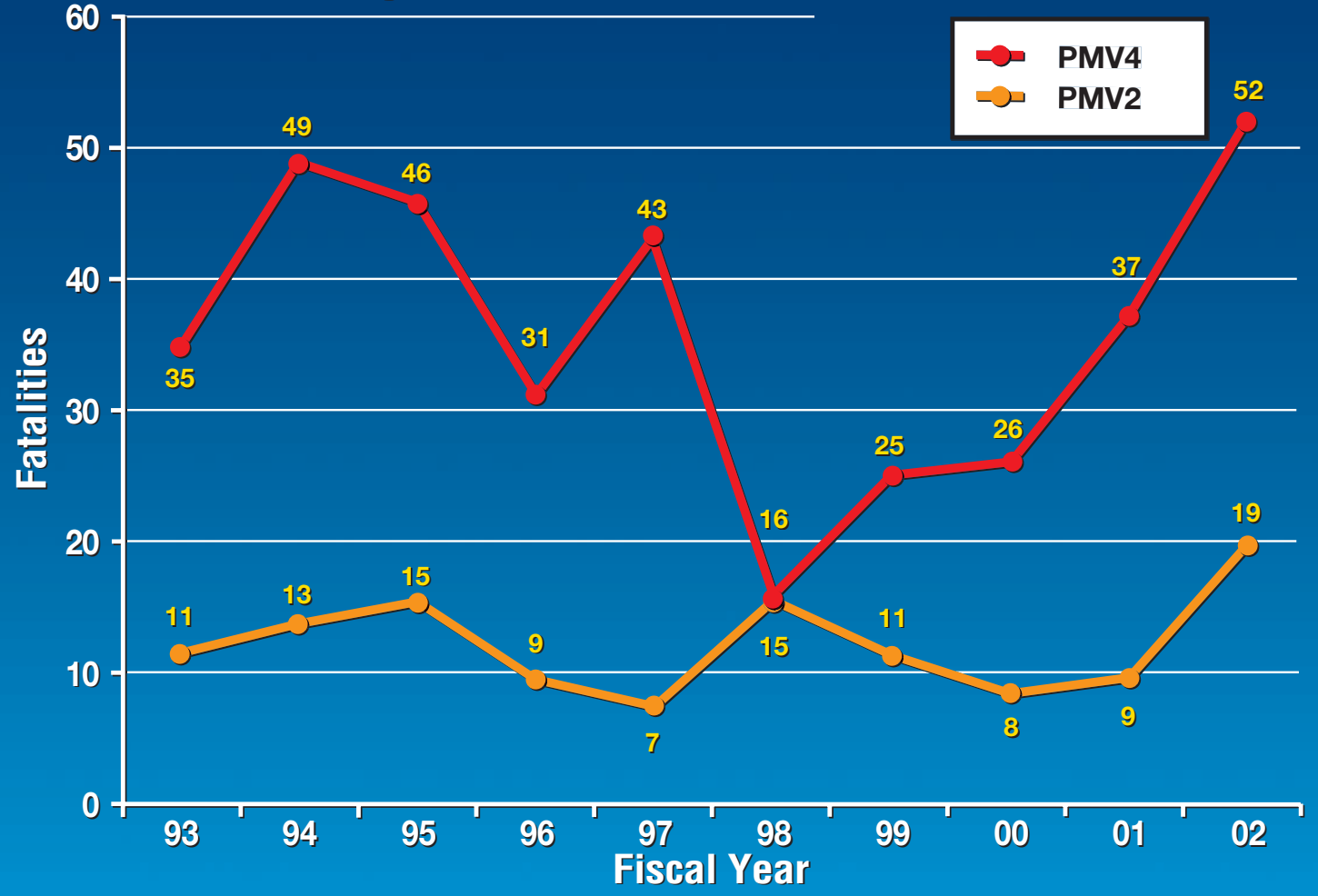


Ground Fatalities by Sub-Type

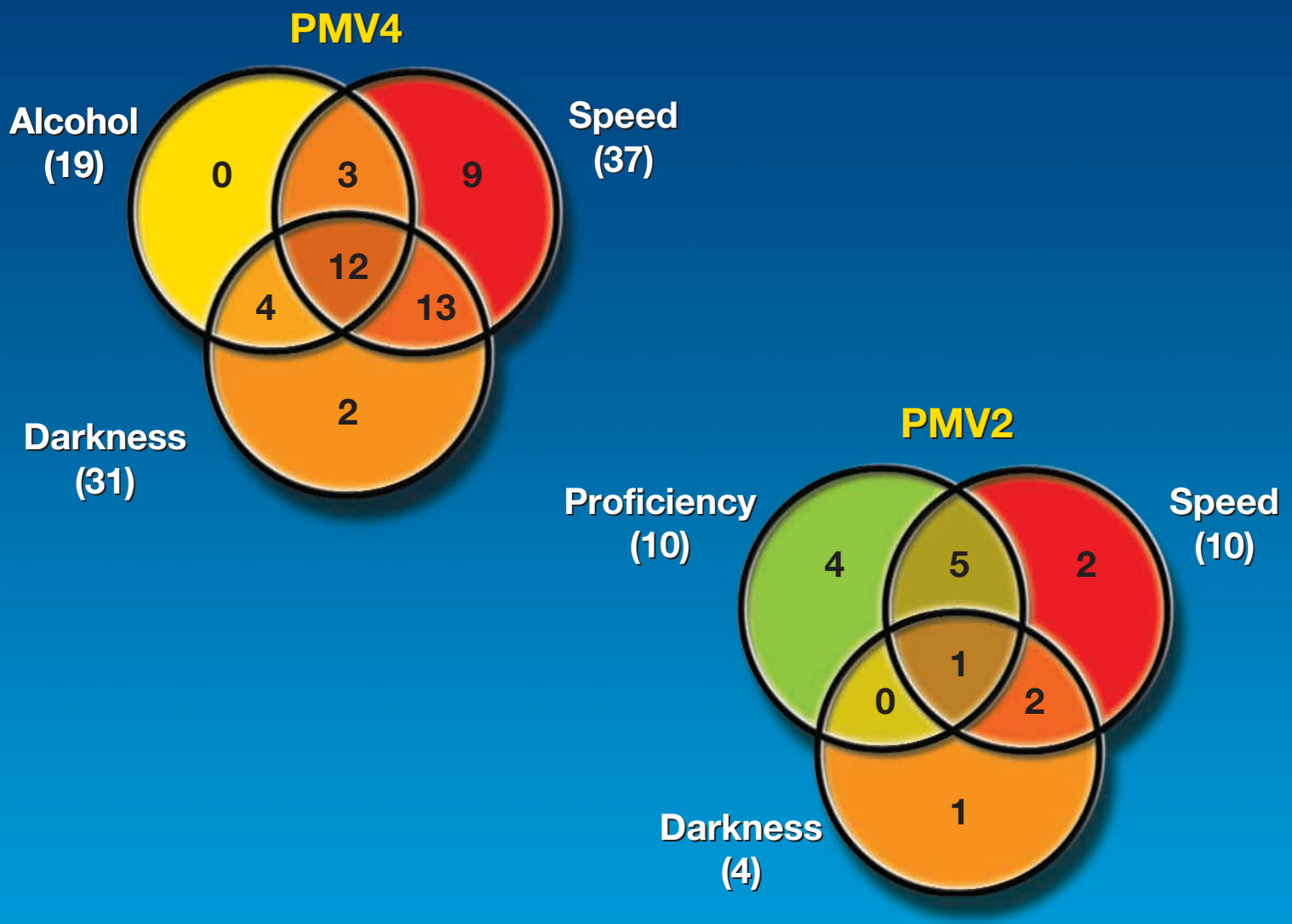
FY93-FY02



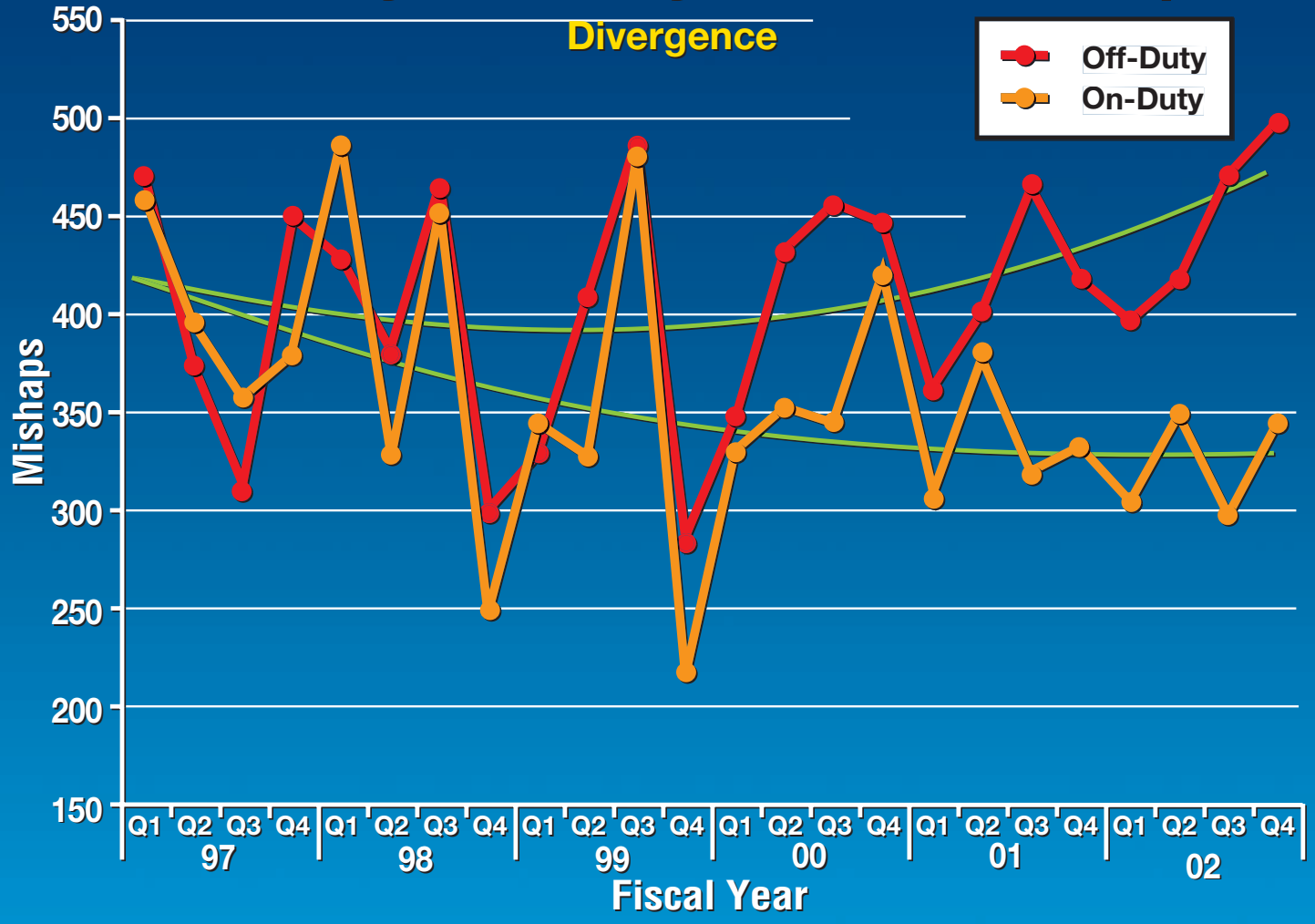
Off-Duty PMV4 vs PMV2 Fatalities



PMV Mishap Factors - FY02



On-Duty/Off-Duty Ground Mishap



See additional note on page 33.

Ground Summary

- The 10-year analysis of ground mishaps shows:
  - 711 AF personnel were killed–average 8 on-duty, 63 off-duty fatalities per year
  - Male, 18-25 age group is major “at risk” category for PMV mishaps
  - Average yearly direct Class A cost to the AF is $34.6M
  - Declining trends in all 3 classes of mishaps
    - In past 5 years, trends are increasing
    - PMV mishaps are the cause for the Class A increases
- Poor risk decisions, faulty judgment are major causal factors
  - Roughly 2/3 of PMV accidents due to poor judgment
  - Any combination of alcohol, speed, and darkness increases risk
  - Lack of proficiency is a major factor in motorcycle mishaps

Notes:

1. P. 25. The 10-year declining trend in Class C mishaps is in concert with the national trend for decreasing occupational mishaps, generally attributed to the maturation of occupational safety requirements and technologies.
2. P. 26. The large mishap cost in FY94 resulted from a KC-135 fire which destroyed the aircraft. This mishap also took 6 lives, explaining the large increase in FY94 on p. 27.
3. P. 26. A KC-135 over-pressurization and a C-17 landing gear mishap caused the large cost increase seen in FY99.
4. P. 32. The reason for this divergence is not known. A possible explanation is the growing tendency among young people to accept high risk. In the off-duty environment, young AF members have much more opportunity to engage in high-risk activities. Planned study efforts will attempt to validate cause factors.

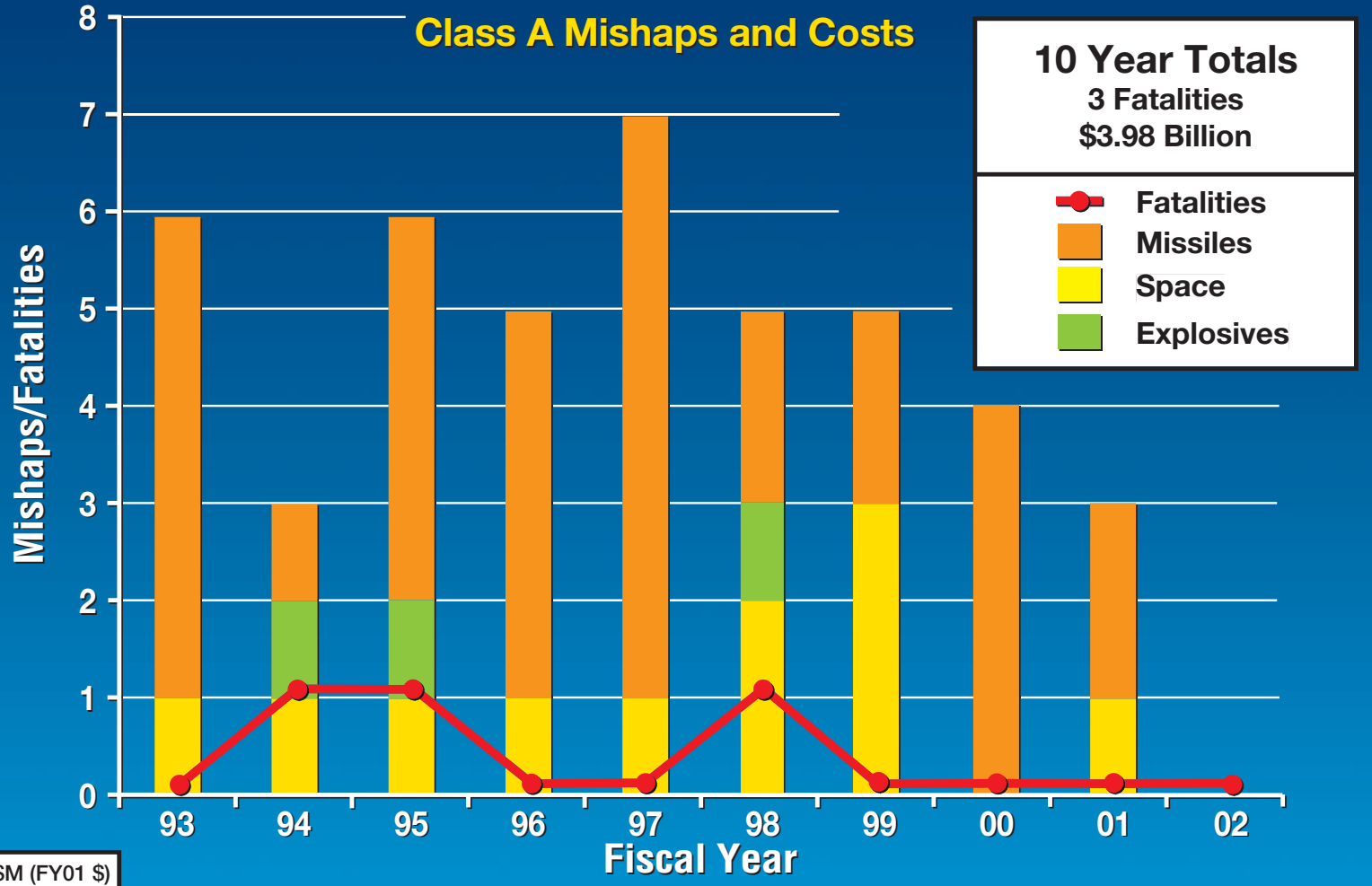
Space, Explosives and Missiles

Space, Explosive and Missile Mishaps

See additional notes on page 37.

Space, Explosives and Missiles

Class A Mishaps and Costs



Cost in $M (FY01 $)										
Space	$987.7	$33.5	$46.5	$50.8	$50.8	$543.5	$2,019.1	$0	$42.0	$0
Explosives	$0	$0.5	$0.7	$0	$0	$0.1	$0	$0	$0	$0
Missiles	$46.6	$2.4	$7.0	$11.3	$3.3	$26.1	$12.8	$34.0	$63.0	$0

See additional note on page 37.

Space, Explosives, and Missiles Summary

- Space, explosive, and missile mishap rates decreasing
- Emphasis on mishap prevention
- Solid, institutionalized risk management philosophy
- Mature system safety approach
- Procedures are prescriptive and enforced

Notes:

1. P. 35. Fifteen of the total FY96 to FY99 Class A mishaps were BQM-106A/B mishaps, predominately due to fin anomalies.
2. P. 35. Between FY97 and FY00, 18 of the Class B mishaps involved missiles, with AIM-120 test-environment failures accounting for half.
3. P. 36. The large space mishap costs were total losses associated with launch and orbital failures: 1993 Titan launch explosion; 1998 Titan/payload destruction; 1999 Titan upper-stage failure and Delta II 2nd-stage failure resulting in missed orbits.

Last 10 Years at a Glance

- 1,024 lives lost in AF mishaps
  - One preventable death every 3.5 days
- 243 aircraft destroyed
  - One preventable Class A mishap every 15 days
- $10.6B in total mishap costs
  - $2.9 million per day

Fatalities			
Category	**FY02**	**10 Yr Avg**	**FY02 vs 10 Yr Avg**
Flight	22	31.0	- 29.0%
Ground (On-Duty)	8	8.2	- 2.4%
Ground (Off-Duty)*	83	62.9	+ 32.0%
Space, Expl & Missiles	0	0.3	- 100.0%
Total	**113**	**102.4**	**+ 10.4%**

* Military Only

Class A Mishaps			
Category	**FY02**	**10 Yr Avg**	**FY02 vs 10 Yr Avg**
Flight	35	30.2	- 15.9%
Ground (On-Duty)	9	11.9	- 24.4%
Ground (Off-Duty)*	84	69.0	+ 21.7%
Space, Expl & Missiles	0	4.4	- 100.0%
Total	**128**	**115.5**	**+ 10.8%**

* Military Only

This report presents a 10-year analysis of US Air Force mishap experience and is intended to support targeted prevention efforts.

The AF will expand on this examination and identify opportunities to achieve a world class safety culture.

"Those who cannot remember the past are condemned to repeat it."

George Santayana (1863-1952)

Additional mishap statistical data is available at the Air Force Safety Center's web site at: http://safety.kirtland.af.mil/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